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KOMMISSIONEN FOR HAVUNDERSØGELSER

SERIE: FISKERI · BIND V

Nr. 8. A. C. JOHANSEN: ON THE LARGE SPRING-SPAWNING SEA HERRING (*CLUPEA*
HARENGUS L.) IN THE NORTH-WEST EUROPEAN WATERS.

KØBENHAVN
I KOMMISSION HOS C. A. REITZEL
BIANCO LUNOS BOGTRYKKERI

1919

MEDDELELSER FRA KOMMISSIONEN FOR HAVUNDERSØGELSER

Serie: Fiskeri.

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MEDDELELSER FRA KOMMISSIONEN FOR HAVUNDERSØGELSER

SERIE: FISKERI · BIND V · Nr. 8 · 1919

ON THE LARGE
SPRING-SPAWNING SEA HERRING
(*CLUPEA HARENGUS*, L.)
IN THE NORTH-WEST EUROPEAN
WATERS

BY

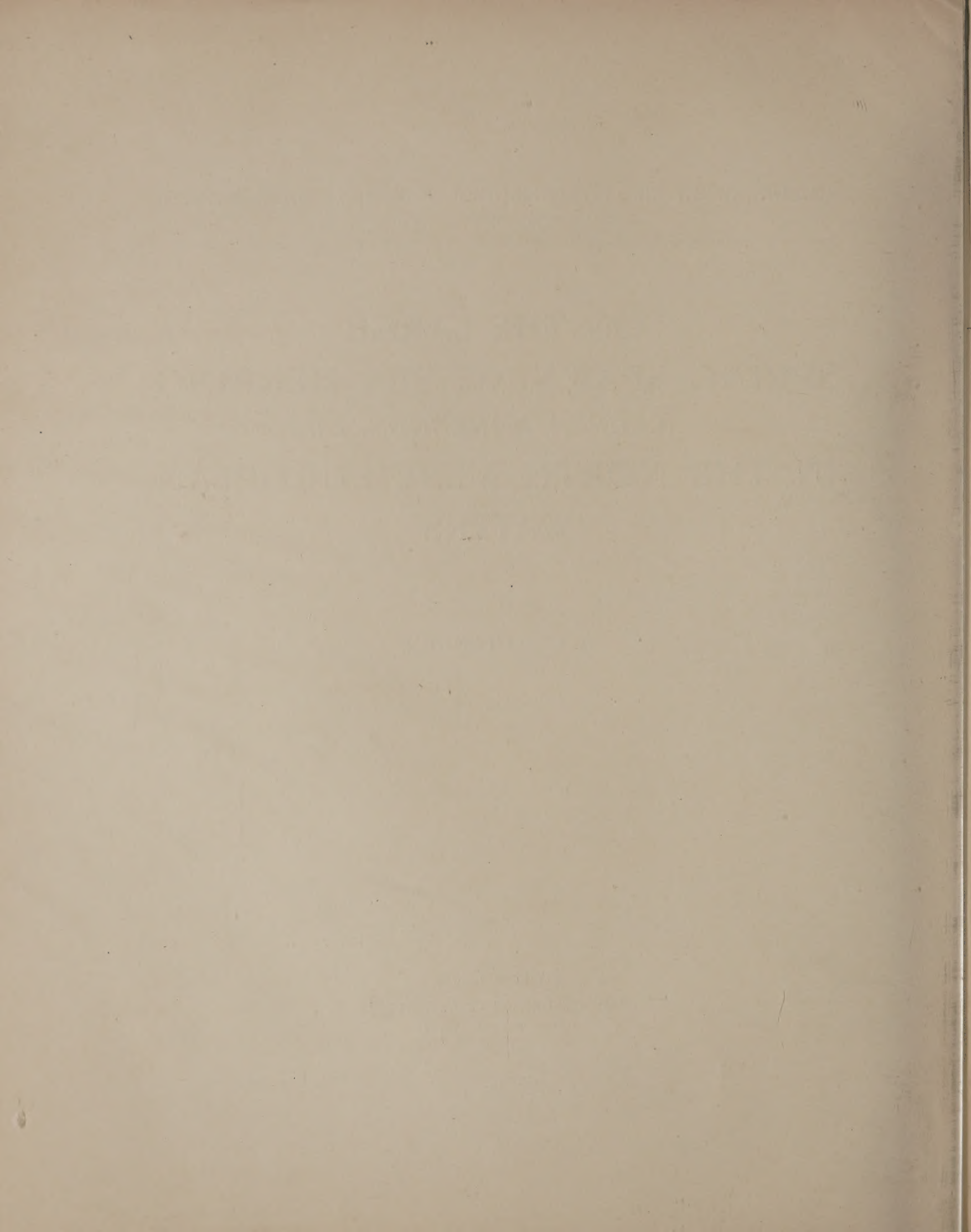
A. C. JOHANSEN

KØBENHAVN

I KOMMISSION HOS C. A. REITZEL

BIANCO LUNOS BOGTRYKKERI

1919



I. Introduction.

DURING my studies of the races and migrations of the Herring in the North European waters, it has caught my attention that the large Icelandic Spring Herring and the large Norwegian Spring Herring resemble each other very closely. Moreover I have found that a number of young fat herrings from the Faroe islands, which I have examined, do not show any peculiar characteristics, but resemble both the large Norwegian Spring Herring and the Icelandic Spring Herring so much that we cannot feel sure that they have developed in the Faroe waters. I regard these observations as so important that I think it right to draw the attention to them already now, though only a few analyses of herrings from Iceland and the Faroes are at hand. Other naturalists as HEINCKE, KNUT DAHL and especially HJ. BROCH have already undertaken several analyses of the Norwegian Spring Herring, in consequence of which the distinguishing marks with regard to the characters, which I have had in view, are rather well elucidated for this herring.

By the preliminary sorting of the herrings I have used the following characters:

A. Total length.

The length is measured from the foremost part of the lower jaw along the median-line of the body over the inner curve on the caudal fin to the utmost point of the dorsal lap of the dorsal fin after

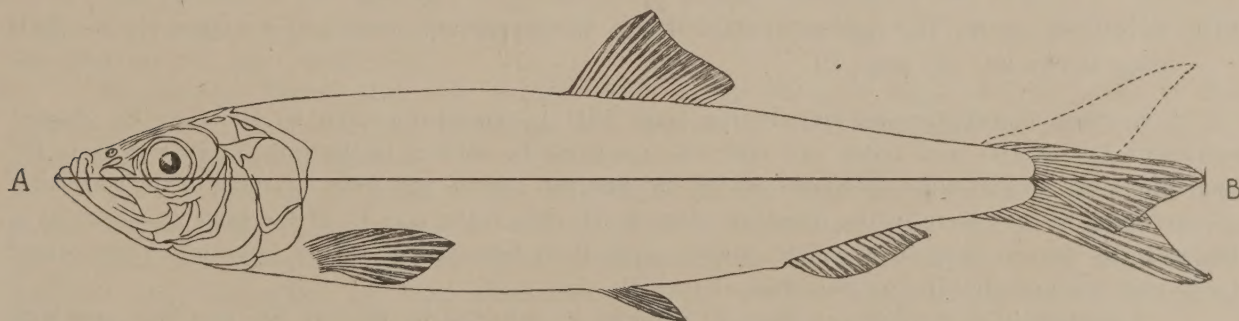


Fig. 1. Total length of a herring. A—B.

this has been turned down off the middle of the body¹. HEINCKE measured the total length of the herring from the foremost part of the lower jaw along the median-line of the body to a line connecting the extreme points of the caudal fin, when it is in its natural position.² It is however connected with a certain

¹ This method is employed by The Board of Agriculture and Fisheries in England. See W. RIDDEL: Report on Herring Measurements. Lancashire Sea-Fisheries Laboratory Rep. No. XXIII for 1914.

² FR HEINCKE: Naturgeschichte des Herings. Abhandlungen d. deutschen Seefischerei-Vereins Bd. II Heft. I u. II 1898.

difficulty to undertake measurements in this way, and moreover it is not easy to determine when the caudal fin is in its natural position when dealing with dead and perhaps preserved specimens. The two methods of measurement give however very nearly the same result. Even for large specimens the difference does not come to more than 1 mm. Sometimes the obtained length has been put down to the nearest integer of centimeters. Sometimes the length is indicated in millimeters.

B. Sex.

C. Maturity.

The Maturity has been determined in a similar way as by HEINCKE, but the determinations are defined more precisely.

Maturity I indicates herrings, which have never spawned and the sex of which as a rule must be determined by the help of a microscope. The height of ovary and testes below 3 à 4 mm.

- II. Herrings with small sexual organs. The eggs may be distinguished by the help of a magnifying glass. In most cases it is a question of herrings which have not obtained maturity. The ovary has as a rule a bright red colour, testes a reddish grey colour. The height of ovaries and testes is ca. 3—8 mm.
- III. The eggs, which can be distinguished with the naked eye, have a diameter of 0.2—0.5 mm. Testes are reddish grey or greyish. The height of the sexual organs is as a rule 8—15 mm.
- IV. The eggs are rather large, ca. 0.5—0.8 mm in diameter. Testes are whitish. The height of the sexual organs is as a rule more than 15 mm.
- V. The sexual organs fill up the whole abdominal cavity. The eggs are about 0.8—1 mm in diameter. Testes milky white.
- VI. The roe and milt running.
- VII. Spents. The ovaries are empty or contain only a few residual eggs. Testes baggy, bloodshot. Small remains of sperma may be present.
- VIII. Recovering spents. The eggs as in stage II, but the ovaries and testes are of a larger size. — This stage passes into the stage III.

A stage almost corresponding to my stage VIII is indicated as IIa by HEINCKE. In younger specimens the ovaries and testes can after the spawning be reduced to the same small size as in the immature stage, but in older specimens we do not find the ovaries and testes as small in any stage after the spawning as they were in the immature stage I—II, even if the eggs be of the same small size as in this stage. In several cases there is only made a distinction between immature specimens (the stages I—II) and mature specimens (the stages III—VIII).

A distinction of the different stages of maturity as indicated by HEINCKE has also been used with certain modifications by other naturalists as: BROCH¹, HJORT & LEA², W. RIDDEL³, ORTON⁴ a. o. In some of the specimens examined the number of winter-rings in the scales have been counted.

¹ HJALMAR BROCH: *Norwegische Heringsuntersuchungen während der Jahre 1904—1906*. Bergens Museums Aarbog. 1908.

² JOHAN HJORT: *Report on Herring-Investigations until January 1910*. Publications de Circonstance. No. 53. Conseil. perm. internat. 1910.

³ W. RIDDEL: *Herring Investigations*, Lancashire Sea-Fisheries Laboratory Report for 1913. No. XXII Liverpool 1914. W. RIDDEL: *Report on Herring measurements* ibid. for 1914 No. XXIII Liverpool 1915.

⁴ J. H. ORTON: *An Account of the Researches on Races of Herrings*, carried out by the Marine Biological Association at Plymouth, 1914—15. *Journal Marine Biol. Assoc.*, Plymouth N. S. Vol. XI No. 1. March 1916.

In the more detailed analyses of the herring for the purpose of characterizing the different races, I have only employed characters which once developed and fixed remain constant during the whole life of the specimen.

I do not mean to say, however, that the relative measures, as the proportion between the different dimensions of the fish, should not be fit to use for race analyses. But before the employment of such relative measures takes place, it ought to be elucidated to what extent these proportions may vary during the development of the specimens and the changing conditions of nature. The very extensive investigation needed to procure the necessary information of this kind have not been carried out as yet. A different treatment of the fish before the measurements, for instance with regard to the conservation, may effect many of the relative measures.

The individual constant characters which I have taken into consideration are as follows:¹

1. Total Number of vertebrae.
2. Number of precaudal vertebrae.
3. Number of keeled scales between the ventral fins and anus.
4. Number of fin rays in both ventral fins.

Each of these characters deserves a closer mention.

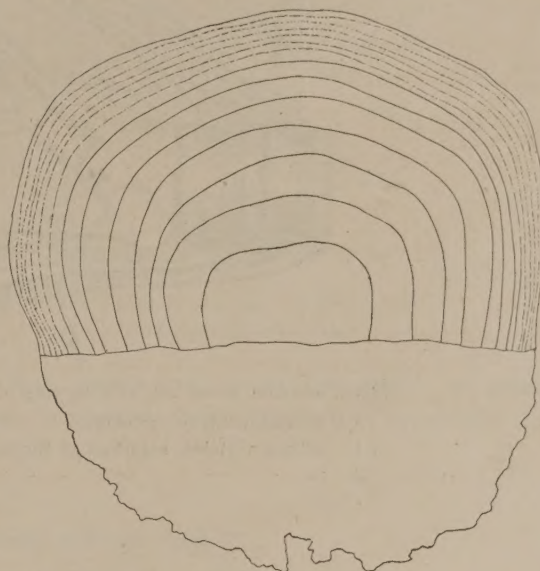


Fig. 2. Scale of a herring of 37.1 cm. Female. Mat. III. Ca. 8:1. Eyjafjord, Iceland. September 1914. — Ca. 13, winter-rings.

1. Total number of vertebrae ("Vert. S.").

The number of vertebrae is a character which is easy to recognise and difficult to misunderstand. It is necessary to define precisely which vertebrae we consider the last or hindmost, as all naturalists do not agree about this.²

We consider like HEINCKE that vertebra the hindmost which in Fig. 3—6 is indicated by the number 1. This vertebra continues backwards and upwards in the urostyle which is partly formed by amalgamated rudimentary vertebrae.

The vertebrae are developed in the larval stage. Already when the specimens have a length of 40 mm the counting can be carried out with exactness, as we can recognise "the last vertebra" by a pair of peculiar backwards pointing processes extending from its lower part (Fig. 3). These characteristic processes exist throughout the later developmental stages and in young and grown-up specimens. (Fig. 3—7).

The rudimentary vertebrae in the urostyle appear most plainly in the young specimens from the end of the larval stage through the transitional stages to the younger completely transformed stages (Fig. 3—4). Even in the grown-up specimens a trace of one of these vertebrae may as a rule be seen.³

¹ By the racial investigations of herrings from certain other areas I have used several other individual constant characters, viz. the number of rays in the dorsal fin, the anal fin, and in one of the pectorals.

² J. H. ORTON considers the vertebra indicated by us in Fig. 3—6 by the number 2 as the last one (l. c. 1916 p. 80).

³ Compare FR. HEINCKE (l. c. 1898), and H. CHARLES WILLIAMSON: A short résumé of the researches into the European races of herrings etc. Rep. Fishery Board of Scotland for 1914.

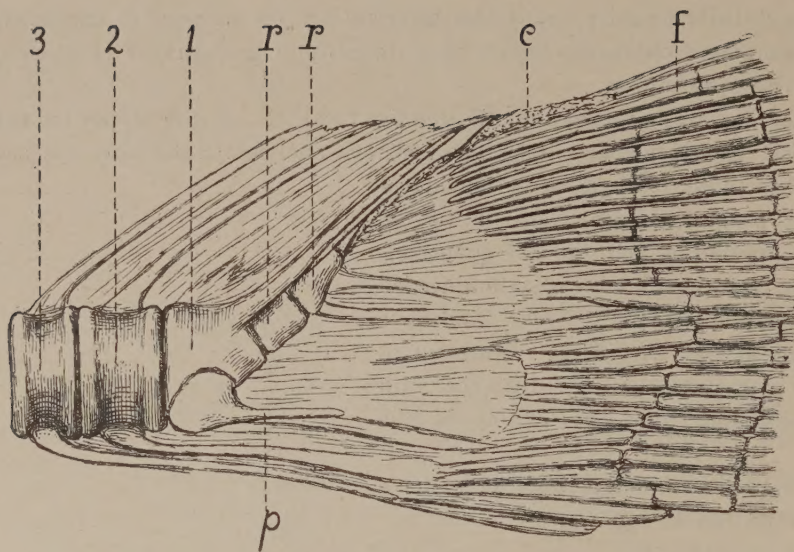


Fig. 3. Caudal bones etc. of a herring of 42 mm. Hornafjord. Iceland. July 28. 1900. Ca. 30:1.

r, r = rudimentary vertebrae.	p = process on the last vertebra.
1 = the vertebra regarded as the last one.	e = chorda?
2 = " " " " " but one.	f = caudal fin rays.

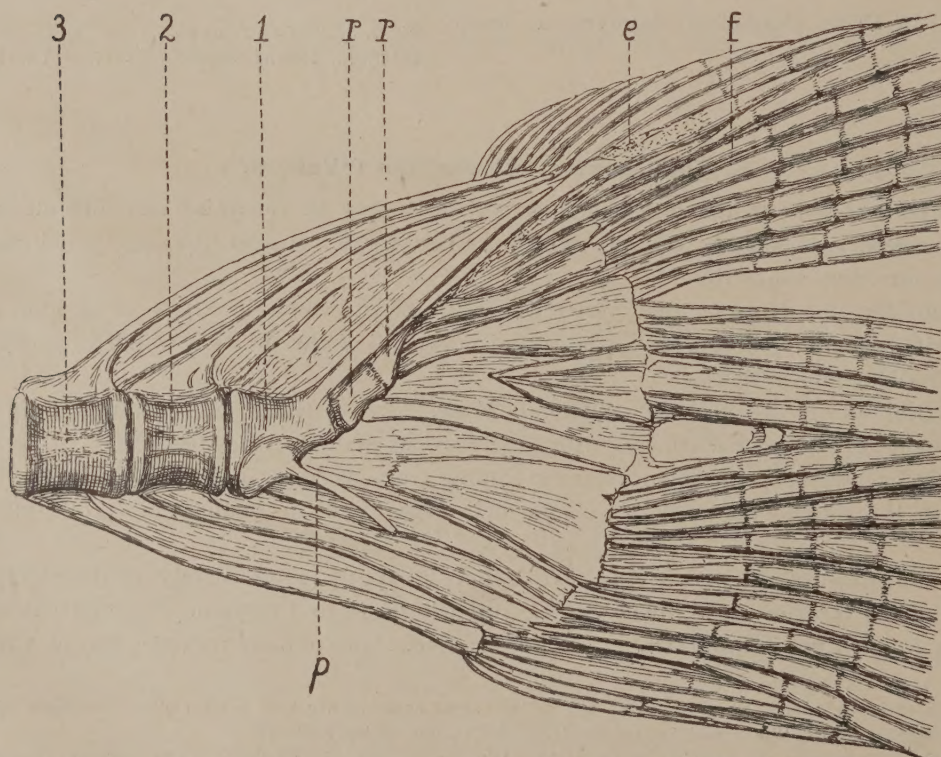


Fig. 4. Caudal bones of a herring of 75 mm. Limfjord. Jutland. January 1916. Ca. 16:1.
The notations as in Fig. 3.

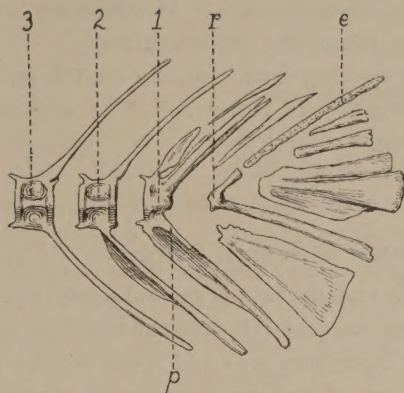


Fig. 5. Caudal bones of a herring of 190 mm. Ca. 4:1.
The Sound off Vedbæk. April 2. 1918.
The bones are separated from each other.
The notations as in Fig. 3.

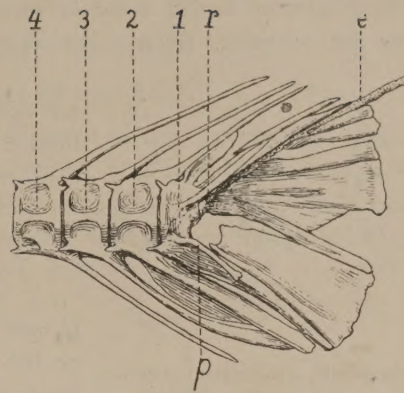


Fig. 6. Caudal bones of a Herring of 230 mm. Ca. 4:1.
♀ Mat. IV.
The Sound off Vedbæk. April 2. 1918.
The notations as in Fig. 3.

(Fig. 5—6). Outside the urostyle it is not frequent, that coalescence or amalgamation of more vertebrae take place. When this has occurred the specimens in question were rejected as unsuitable for statistical treatment.

2. Number of precaudal vertebrae ("Prec. Vert."),

which are here determined as: Number of vertebrae in front of that vertebra, which carries the first closed hæmal arch. This character is easily recognised, but the skeletonizing must be carefully undertaken, as otherwise it may happen that the cross pieces to the foremost hæmal arches can be broken off. In this case it is not certain, that the number of precaudal vertebrae can be determined with certainty. To this comes, that it seems to be rather casual, if the hæmal arch becomes closed or not. Incomplete, not quite closed, hæmal arches occur frequently (Fig. 8), and it happens, that one or more incomplete arches occur behind a quite closed hæmal arch. The bony cross pieces are developed much later than the bony of the vertebra.

This character is more variable than the preceding one, and I think it probable that the environments have here a greater influence than in the case of Vert. S.

The characters mentioned here: The precaudal vertebrae is equal to the character employed by HEINCKE: "Vert. H." minus 1, as HEINCKE has reckoned with the serial number of that vertebra which carries the first closed hæmal arch.

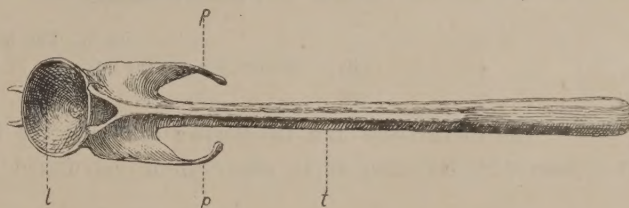


Fig. 7. The last vertebra. Ca. 8:1.
1 = body of vertebra.
p = processes pointing backwards and downwards.
t = process pointing downwards.

3. Number of keeled scales between the ventral fins and anus ("K 2").

It is here of importance to settle, which keeled scale we regard as the foremost one. This is shown on Fig. 9. The scale *a* is (as by HEINCKE) regarded as the foremost. It is placed off the foremost part of the basis of the ventral fins.

The hindmost keeled scale is sometimes rudimentary, consequently it is necessary to be very cautious by the counting. Even the most rudimentary scale is taken into consideration.

The keeled scales develop later than the vertebrae. They do not occur till the transformation is completed. The specimens have then a length of ca. 50 mm.

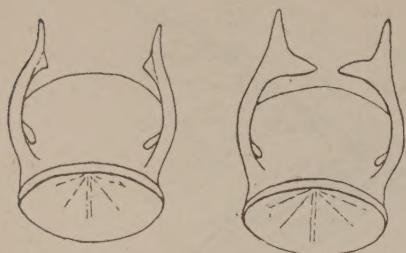


Fig. 8. Vertebrae with incomplete, not quite closed haemal arches. After ORTON.

4. Number of ventral fin-rays.

The number of ventral fin-rays is generally easily recognised. If one or both ventral fins were plainly abnormal owing to damage or for other reasons the specimen was not used by the statistical treatment. The total number of rays in both fins is stated together.

I have always determined the maturity of the specimens myself. The skeletonizing and numeration has been undertaken by Hr. cand. phil. S. W. FOGH. The counting of vertebrae, keeled scales etc. were carried out partly by Hr. mag. scient P. L. KRAMP, partly by myself. In more difficult cases control countings have taken place. The calculations have been undertaken by Fru E. NEERGAARD-MÖLLER.

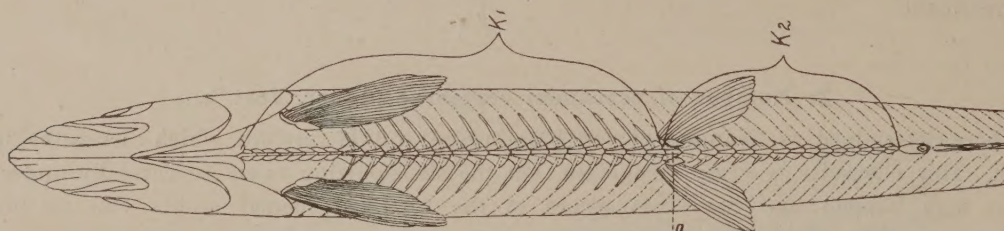


Fig. 9. The keeled scales.
K₁ — before the ventral fins. K₂ — between the ventral fins and anus.

The notations and formulae used are the following:

σ = standard deviation of an observation, calculated by

$$\sigma = \pm \sqrt{\frac{\sum p a^2}{n-1}} = \pm \sqrt{\frac{1}{n(n-1)}} \cdot \sqrt{n \sum p a^2 - (\sum p a)^2}$$

where p = Number of variates in the separate classes.

α = Deviation of a variate from the mean.

n = Total number of variates.

a = Deviation of a class of variates from the starting point for the calculation of the mean.

m = Mean value of observations.

σ_m = Standard deviation of the mean, calculated by $\sigma_m = \frac{\sigma}{\sqrt{n}}$.

σ_σ = Standard deviation of σ , calculated by $\sigma_\sigma = \frac{\sigma}{\sqrt{2n}}$.

Standard deviation of a difference ($m_1 - m_2$), calculated by $\sqrt{\sigma_{m_1}^2 + \sigma_{m_2}^2}$.

In examining the results of the statistical analyses I have received some valuable hints from Frøken KIRSTINE SMITH, D. Sc. Most of the figures have been drawn by Frøken B. ROHWEDER.

II. The Icelandic Spring-Herring.

The Herring at the north coast of Iceland.

The majority of the Icelandic herrings which I have disposed of for investigation, originate from the area about Eyjafjord on the north coast. By the obligingness of Dr. JOHS. SCHMIDT and Dr. BJ. SÆMUNDSSON in Reykjavik, I received from the Icelandic merchant JACOB BJÖRNSSON in Svalbarðeyri a sample of herrings of the usual merchandise from the north coast, captured in September 1915. Of the sample 192 specimens were examined, the size of which was as follows:

cm	♂	♀	?(steril)	Total
28	1	..	..	1
29	1	1	..	2
30	..	..	..	..
31	2	4	..	6
32	10	19	..	29
33	26	33	..	59
34	22	49	..	71
35	3	13	..	16
36	2	5	1	8
	67	124	1	192

Average length: 33.2 cm 33.5 cm 33.4 cm (+ 0.5 cm)

The specimens in question had either spawned earlier or would obtain maturity in the next spawning season.

The number of vertebrae, keeled scales and ventral fin-rays of the specimens examined, was as follows:

Vert S.		Precaudal Vert.		K 2		Vent. fin-rays	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
56	14	22	1	12	5	16	5
57	106	23	20	13	53	17	17
58	60	24	90	14	104	18	161
59	12	25	64	15	28	19	5
..	..	26	15	16	2	20	4
..	..	27	2	..	..	..	..
<i>n</i>	192		192		192		192
<i>m</i>	57.36		24.41		13.84		17.93
σ	0.71		0.84		0.74		0.55
σ_m	0.051		0.061		0.053		0.040
σ_σ	0.036		0.043		0.038		0.028

For the characters examined the standard deviation (σ) is here of the same value as we usually find it by analyses of spawning herrings from the same shoal.

Thus the size of σ does not point in the direction that we have to do with a mixture of different races, but the possibility is not excluded, that the sample investigated can have been a mixture, e. g. of two races which approaches each other.

When and where does the spawning take place of the large sea herring, which is captured at the north coast of Iceland in summer?

At the North of Iceland from Cape North on the Northwestland to Cape Langenæs on the Northeastland an extremely important herring fishery with purse seines and drift nets takes place from July to the middle of September, especially from Icelandic and Norwegian side. The herring which is chiefly

captured here is a very large, rather fat sea herring of a length of ca. 30—40 cm with an average length of ca. 35 cm.

As we do not know spawning herrings from the northland and the eastland, and as Dr. JOHNS. SCHMIDT during his investigations at the coasts of Iceland in the years 1903—05, observed that the young herring fry was wanting at the north- and eastcoast in spring and early summer but occurred at the south- and westcoast,¹ both he and SÆMUNDSSON² concluded, that the herring does not spawn at the north- and eastcoast, but at the south- and westcoast, and that it migrates to the north- and eastland after the spawning season.

The Norwegian naturalist LEA has investigated the state of sexual organs, fat, age etc. of 419 herrings caught in purse-seine 3 km N. of Siglunæs at the entrance to Eyjafjord on July 25. 1903. The specimens in question were of a length of 31—39 cm. For 414 of these herrings Lea indicates the maturity as II, for two females of 35 and 36 cm and one male of 37 cm the maturity is put down as III, and for a female of 37 cm maturity IV is stated. For the great majority of these herrings the amount of fat contained in ventral cavity is indicated by 2 (middling fat) and for several by 3 (fat in large quantities) and for a few by 1 (a little fat). The rather considerable amount of fat shows that the specimens in question have not spawned recently.

LEA has moreover investigated 210 grown-up sea herrings of a length of 31—38 cm captured at the North of Iceland in September of 1909. The maturity of most specimens was now II, II—III, III or III—IV. Eleven males showed maturity IV and three males maturity IV—V. Most specimens are indicated "middling fat".

The specimens examined were thus on an average somewhat nearer the mature stage than the specimens from July, but none of the females were near the spawning stage as yet. We often see in autumn that the sexual organs are strongly developed, especially in the males, (maturity III, IV or IV—V) almost half a year before spawning takes place.

Most of the specimens from the northland, which I have examined, showed (in September) the maturity VIII, III and III—IV (see Table II p. 36—37).

All in all, the analyses which LEA and I have undertaken, suggest that the majority of the large sea herrings occurring at the north coast of Iceland in summer, spawn in spring. Our investigations give no information with regard to the spawning place.

The Herring at the south-eastern and south-western coasts of Iceland.

In the summer of 1900 I took part as a naturalist in the cruise of the Danish naval schooner "Diana" to the coasts of Iceland, and I had here an opportunity to capture quite young herrings in the Hornafjord at the south-east coast. In an Ammodytes-seine I captured here on July 28. ca. 200 herrings of a length from 3.5 to 15 cm, belonging to two different size-groups. Of the youngest group 46 specimens measured were of the following length:

3.5 cm.	1 specimen
4 -	20 —
4.5 -	21 —
5 -	2 —
5.5 -	2 —
	46 specimens

¹ JOHNS. SCHMIDT: Fiskeriundersøgelser ved Island og Færøerne i Sommeren 1903. Skrifter udg. af Kommissionen for Havundersøgelser No. 1. København 1904.

² BJARNI SÆMUNDSSON: Oversigt over Islands Fiske. Skrifter udg. af Kommissionen for Havundersøgelser. No. 5. København 1908.

³ JOHAN HJORT: Report on Herring-investigations until Januar 1910. Publications de circonstance. No. 33. Conseil perm. internat. 1910.

The size of these specimens makes it probable that they were developed in early spring of the year 1900.

The number of vertebrae was examined in 16 specimens of a length of 40—46 mm, and the counting gave the following result:

Number of vertebrae	Frequency	m	57.56
56	1	σ	0.81
57	7	σ_m	0.20
58	6	σ_σ	0.14
59	2		
n	16		

HEINCKE has investigated the number of vertebrae in 10 specimens of a length of 50—70 cm, which were captured at Reykjavik in December 1878. The counting gave the following result:

Vert. S.		m	57.50
Number	Frequency	σ	0.53
57	5	σ_m	0.17
58	5	σ_G	0.12
n	10		

It is not known whether these specimens originate from spring-spawning herrings or from summer-spawning herrings.

HEINCKE has moreover investigated the number of vertebrae and keeled scales (K 2) of 24 grown-up specimens and the number of ventral fin-rays in 12 grown-up specimens from Iceland. The place of capture and the spawning season for these herrings is unknown. The question is about specimens of a length of 29—35 cm.

The number of vertebrae, keeled scales and ventral fin-rays was as follows:

Vert. S.		K 2		Rays in ventr. fins	
Number	Frequency	Number	Frequency	Number	Frequency
56	3	12	1	16	1
57	11	13	7	17	1
58	10	14	10	18	9
..	..	15	6	19	1
n	24		24		12
m	57.29		13.88		17.8
σ	0.70		0.85		0.7
σ_m	0.14		0.17		0.20
σ_σ	0.10		0.12		0.14

By comparing the quoted values for the vertebrae of the herring from Eyjafjord, Hornafjord og Reykjavik it will be seen, that differences of any importance can not be pointed out.

At the western and southwestern coasts of Iceland we find besides the spring herring also a summer-spawning herring, which according to SÆMUNDSSON (l. c. 1908 p. 103) spawns in July and August. This herring has about the same size as the spring herring (see p. 27—28), its racial characteristics are however unknown.

III. The Faroese Herring.

By the kindness of Dr. JOHS. SCHMIDT I have received a sample of salted herrings for investigation from the Faroe islands.

The herring was captured in Skaalebotten inmost in Kongshavn at 19—23 m on September 10, 1915. Of the sample 216 specimens were examined. Out of these 207 specimens were of maturity I or II and of a length of 20—27 cm (see Table II, p. 39). The number of vertebrae, keeled scales (K 2) and ventral fin rays of the 207 specimens examined was as follows:

Vert. S.		Precaudal Vert.		K 2		Rays in ventr. fins	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
55	1	22	2	12	2	16	9
56	12	23	18	13	59	17	13
57	93	24	102	14	116	18	183
58	91	25	63	15	28	19	2
59	10	26	17	16	2	..	..
..	..	27	3	..	..	..	..
..	..	28	2	..	..	..	..
<i>n</i>	207		207		207		207
<i>m</i>	57.47		24.44		13.85		17.86
σ	0.70		0.92		0.69		0.48
σ_m	0.049		0.064		0.048		0.033
σ_σ	0.035		0.045		0.034		0.023

It will be seen that we have here for all four characters practically the same average values as for the Icelandic herring. If we compare the figures found for the samples from Eyjafjord and Kongshavn, we obtain the following result:

Diff. Vert. S.	Kongshavn minus Eyjafjord	+ 0.11	Standard deviation of diff.	0.071
— Prec Vert.	—	+ 0.03	—	0.088
— K 2	—	+ 0.01	—	0.071
— Ventr. rays	—	÷ 0.071	—	0.052

The standard deviation (σ) for the characters examined is here of about the same size as for the sample from the north coast of Iceland.

The spawning season for the fat herrings examined is unknown, and we do not know either if they were developed at the Faroes. As they bear a close resemblance to the Icelandic and Norwegian spring herrings, but differ widely from the Shetlandic and Scottish summer and autumn spawning herrings, o. a. with regard to the number of keeled scales, the probability is that the majority are spring spawners. The central area in the scales is as a rule small.

I am indebted to Dr. JOHS. SCHMIDT for the information that a spring spawning herring occurs and spawns at the Faroe islands. This may e. g. be seen from the fact, that a considerable amount of young herring fry of an average length of 10—11 mm (minimum size ca. 8 mm) were captured in Trangisvaag Fjord from the Danish motor schooner "Margrethe" at the beginning of June 1913.

In the examined sample from Kongshavn a quite few mature herrings occurred. They were of a length of 28—31 cm, and at least some of them were spring-spawners. (See Table II).

The number of vertebrae, keeled scales and ventral fin rays in 9 mature herrings of the sample was as follows:

Vert. S.		Precaudal Vert.		K 2		Rays in ventr. fins	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
55	1	23	3	13	3	16	1
56	..	24	4	14	4	17	..
57	6	25	1	15	2	18	8
58	2	26	1	..	..	..	..
<i>n</i>	9	..	9	..	9	..	9
<i>m</i>	57.0	..	24.0	..	13.89	..	17.78

It is not known whether these mature specimens belong to the same race as the immature ones.¹

IV. The large Norwegian Spring Herring.

Among the Norwegian fishermen and commercials the large Norwegian spring herring is generally divided into four different main groups: Small Herrings, Fat Herrings, Large Herrings and Ripe Herrings (named Vaarsild, spring herrings).

Quite irrespective of the question if the large Norwegian spring herrings belong to one single race or to two (or more) different races, it is beyond doubt that within one and the same race all four categories are present. Regarding these different categories Dr. HJORT writes as follows:²

¹ The number of winter-rings in the scales of 91 immature specimens of the sample from Kongshavn ¹⁰/₉ — 1915 was counted as follows:

Length of specimens cm	Distribution of specimens according to the number of winter-rings					
	1	2	2—3	3	3—4	4 winter-rings
20	2	1	..	..	..	..
21	..	6	..	..	..	..
22	..	12	1	1	..	..
23	..	9	1	2	1	..
24	..	9	..	9	..	..
25	..	3	..	13	..	..
26	..	..	2	12	..	1
27	..	..	..	3	..	1
28	..	..	..	..	..	..
29	..	..	..	2	..	..

As we have probably to do with spring-spawners, the specimens with 1 winter-ring are developed in 1914, the specimens with 2 winter-rings in 1913, and so on. The specimens of an age of 2½ years have an average length of 22—23 cm and the specimens of 3½ years, an average length of ca. 26 cm.

The number of winter-rings in the scales of 9 mature specimens picked out among a great number of immature ones was as follows:

Length of specimens cm	Distribution of specimens according to the number of winter-rings						
	3	4	5	5—6	7	6—8	8 winter-rings
28	1	..	..	..	..	..	—
29	..	..	1	..	..	..	—
30	1	1	..	..	1	1	—
31	..	..	..	1	..	..	—

In samples where the younger year-classes are predominating and where only a few specimens of the older year classes are present, these older specimens are as a rule far below the average size of the year-class in question.

LEA has made investigations as to age, maturity etc. of a great number of herrings caught in Faroese fjords in September of 1909. He found as a rule a large central area in the scales, and states for most specimens of 26 cm and above a maturity of III, III—IV or IV. LEA evidently is of opinion that most of these specimens were autumn spawners. I consider it a possibility that LEA here mainly has had to do with spring-spawners, in the scales of which the first winter-ring has been slightly developed and therefore often overlooked. The average size of 138 specimens with "2 winter-rings" investigated by LEA was 26.3 cm, or about the same as the average size of 44 specimens with "3 winter-rings" investigated by me (average 26.0 cm). — See HJORT: Report on Herring-investigations. 1910.

²) JOHAN HJORT: Fluctuations in the great Fisheries of Northern Europe. — Rapports et Procès-Verbaux. Conseil perm. internat. Vol. XX. Copenhague 1914 p. 15—16.

"The method of distinguishing between the four sorts of fish, which has been in use for a great number of years, is based principally upon the size, degree of fatness, and development of the genital organs (ovaries and milt).

The small herring do not exceed 19 cm in length, the ovary or milt is, at the utmost, only visible as a thin thread below the spine; in point of fatness they are far inferior to the fat herring.

The fat herring vary as a rule in size from 19 to 26 cm, the genital organs of the lesser fish are very small, incipient development being noticeable in the case of the larger. The adipose deposit however, in the flesh and round the intestines ("ister") is much more developed than in any other class of herring.

The large herring are superior in size, running as a rule from 27—32 cm, their genital organs are, from the autumn, in advancing development towards maturity. This class of fish thus corresponds to that known in the North Sea fishery as "fulls". In the course of this development the adipose deposit gradually decreases in quantity, and the fish finally pass, by imperceptible degrees, into the class of spring herring, which are the spawning fish. Among these latter, the ovaries are in January firm, in February and March slack, and in April entirely spent, the fish at this time being also thin and in poor condition.

Small herring and fat herring are thus immature fish, the large and spring herring being mature."

Besides the large Norwegian spring herring local herring races occur in certain of the Norwegian fjords, e. g. in Beistadfjord and Trondhjemsfjord, as proved by BROCH.¹ These local races differ from the large spring herring by being smaller forms with a lower number of vertebrae and keeled scales and by having a later spawning season etc.

HEINCKE has analysed a small number and HJ. BROCH a larger number of the large Norwegian spring herring at the different stages of maturity.

We shall now regard the results of the most important of these analyses, and treat them statistically in a similar way as the samples mentioned above.

Utsire (S.W. Coast of Norway c. 59°20' N. Lat.).

HEINCKE examined the number of vertebrae in 52 spawning spring herrings captured in February 1888 by UTSIRE at the southwestern coast of Norway and 9 spring herrings captured in the same place but without statement of the time of capture. The number of vertebrae (Vert. S.) was as follows:

Number	A	B	A + B
56	10	..	10
57	14	3	17
58	20	2	22
59	7	4	11
60	1	..	1
<i>n</i>	52	9	61
<i>m</i>	57.52	58.11	57.61
σ	1.01	0.93	1.2
σ_m	0.14	0.31	0.13
σ_σ	0.10	0.22	0.092

HEINCKE gives the number of keeled scales (K 2) and ventral fin rays for the following spring herrings captured at the south-western coasts of Norway by Utsire and Nordvaag (l. c. p. 82—86).

¹ HJALMAR BROCH: Norwegische Heringsuntersuchungen während der Jahre 1904—1906. Bergens Museums Aarbog 1908. No. 1.

K 2		Rays in vent. fins ¹	
Number	Frequency	Number	Frequency
13	3	16	1
14	4	17	1
15	2	18	48
<i>n</i>	9		50
<i>m</i>	13.89		17.94
σ	0.78		0.31
σ_m	0.26		0.044
σ_σ	0.18		0.031

Haugesund (ca. 59°25' N. Lat.).

HJ. BROCH investigated 70 mature spring herrings (maturity V—VI) captured at Haugesund, on March 10. and 24. 1905. The size of the specimens was 25—35 cm, on an average ca. 30 cm. The number of vertebrae, keeled scales and ventral fin rays was as follows (l. c. p. 55—57):

Vert. S.		Precaudal vert.		K 2		Rays in vent. fins	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
56	2	23	6	11	1	15	1
57	27	24	30	12	2	16	2
59	34	25	24	13	8	17	5
59	6	26	8	14	39	18	61
60	1	27	2	15	20	..	..
<i>n</i>	70		70		70		69
<i>m</i>	57.67		24.57		14.07		17.83
σ	0.73		0.91		0.81		0.54
σ_m	0.088		0.11		0.096		0.065
σ_σ	0.062		0.077		0.068		0.046

Haugesund (ca. 59°25' N. Lat.).

No. of specimens: 100. Maturity V—VI. Date of capture: March 1906. Size of specimens 24—35 cm, average about 29 cm. Spring herrings. The number of vertebrae and keeled scales was as follows:²

Vert. S.		K 2		Vert. S.		K 2	
Number	Frequency	Frequency		<i>m</i>			
56	3			σ	57.60	14.07	
57	40			σ_m	0.65	..	
58	51			σ_σ	0.065	..	
59	6				0.046	..	
<i>n</i>	100		100				

Solsvik (in the Bergen area, ca. 60°30' N. Lat.).

No. of specimens 30. Maturity IV—VI. Size 26—35 cm. Date of capture: February 15. 1905. The number of vertebrae, keeled scales and ventral fin-rays was as follows:

Vert. S.		Precaudal vert.		K 2		Rays in ventr. fins.	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
56	1	23	4	13	5	17	4
57	17	24	6	14	11	18	26
58	10	25	13	15	14	..	..
59	2	26	6	..	..	..	..
..	..	27	1	..	..	..	..
<i>n</i>	30		30		30		30
<i>m</i>	57.43		24.8		14.30		17.87
σ	0.67		1.03		0.75		0.35
σ_m	0.122		0.19		0.14		0.06
σ_σ	0.087		0.13		0.096		0.045

¹ Besides 1 specimen with 13 ventral fin rays (8 + 5) where the ventral fin undoubtedly is abnormal or damaged.

² BROCH's graphical figures are not always in accordance with the mean values stated in his text. Where BROCH only has published his material in the form of graphical figures, the exact number of variates cannot in all cases be seen. A part of BROCH's material could for this reason not be used for the present representation of the detailed analyses.

Aalesund (ca. 62°30' N. Lat.).

No. of specimens: 100. Maturity IV—V. Average length ca. 31.5. Large Herrings ("Storsild"). Date of capture: January 1905.

Vert. S.		K 2	
Number	Frequency	Number	Frequency
56	5	13	12
57	38	14	60
58	54	15	25
59	3	16	3
<i>n</i>	100		100
<i>m</i>	57.55		14.19
σ	0.64		0.68
σ_m	0.064		0.068
σ_σ	0.045		0.048

Aalesund (ca. 62°30' N. Lat.).

No. of specimens: 100. Maturity IV. Size 29—37 cm. Large Herrings ("Storsild"). Date of capture: January 1906:

Vert. S.		K 2	
Number	Frequency	Number	Frequency
56	7	12	1
57	46	13	21
58	41	14	59
59	6	15	19
<i>n</i>	100		100
<i>m</i>	57.46		13.96
σ	0.80		0.88
σ_m	0.80		0.088
σ_σ	0.057		0.062

The quoted analyses of the Spring herring of maturity IV—VI captured between Haugesund and Aalesund do not differ significantly. If we put them together we obtain the following result:

Vert. S.		Precaudal Vert.		K 2		Ventr. fin-rays	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
56	28	23	10	11	1	15	1
57	185	24	36	12	3	16	3
58	212	25	37	13	49	17	10
59	34	26	14	14	173	18	135
60	2	27	3	15	80	..	..
..	..	..	..	16	3	..	..
<i>n</i>	461		100		309		149
<i>m</i>	57.56		24.64		14.06		17.87
σ	0.74		0.95		0.72		0.44
σ_m	0.034		0.095		0.041		0.036
σ_σ	0.026		0.067		0.029		0.025

Skagerrak.

Broch examined 31 full herrings captured by Risør on January 13. and 27. of 1906. The Maturity was III—IV. The length 252—289 mm.

The investigation gave the following result:

Vert. S.		Precaudal Vert.		K 2		Rays in ventr. fins	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
56	2	23	2	12	1	17	2
57	12	24	11	13	5	18	28
58	16	25	13	14	20	..	..
59	1	26	3	15	5	..	..
..	..	27	2	16	..	..	..
<i>n</i>	31		31		31		30
<i>m</i>	57.51		24.74		13.94		17.93
σ	0.68		0.965		0.68		0.25
σ_m	0.12		0.17		0.12		0.046
σ_σ	0.086		0.12		0.086		0.033

DAHL investigated a sample of herrings, captured in the Skagerrak near the Norwegian coasts on March 4th 1907.¹ The investigation gave the following result (DAHL gives only the average figures):

	Vert. S.	Precaudal vert.
42 spec. Mat. (I) III—V	57.57	24.57
110 — — VII	56.55	23.89

The 42 specimens of maturity III—V are, as stated by DAHL, Norwegian spring herrings, and the 110 specimens are autumn spawning herrings.

It will be seen, that on the basis of the analyses at hand, there is no reason to suppose, that the Norwegian Skagerrak herrings differ from the south west Norwegian spring herrings, which are captured at the Northsea coasts of Norway.

We shall now regard the most important of BROCH's analyses of large herrings and fat herrings from the more northern parts of the Norwegian coastal areas.

Trondhjem District. 64—65° N. Lat.

Halten Bank and Halten Deep. "Michael Sars". St. 9 and St. 22. Sept. 22. and Oct. 31 1905. Maturity III. The average length of specimens 29.8 cm. Large Herrings ("Storsild").

Vert. S.		Precaudal Vert.		K 2	
Number	Frequency	Number	Frequency	Number	Frequency
56	2	23	2	13	4
57	8	24	11	14	14
58	9	25	5	15	2
59	1	26	2	..	..
<i>n</i>	20		20		20
<i>m</i>	57.45		24.35		13.90
σ	0.76		0.81		0.55
σ_m	0.17		0.18		0.12
σ_σ	0.12		0.13		0.087

Nordland District.

Sklinna Bank and Sklinna Deep 65—69° N. Lat. — "Michael Sars" St. 8, 19, 24. Septbr. 26., October 24. and Nov. 3. 1905. — Maturity III. Average length 29.9. Large Herrings ("Storsild").

¹ KNUT DAHL: The scales of the herring. Report on Norwegian Fishery and Marine Investigations. Vol. II, Part II. Bergen 1907 (1909).

Vert. S.		Precaudal Vert.		K 2	
Number	Frequency	Number	Frequency	Number	Frequency
56	2	23	5	13	12
57	16	24	9	14	12
58	11	25	14	15	4
59	1	26	2	16	2
<i>n</i>	30		30		30
<i>m</i>	57.37		24.43		13.87
σ	0.67		0.85		0.88
σ_m	0.12		0.16		0.16
σ_σ	0.086		0.11		0.11

Træna Bank and Træna Deep. 66—67° N. Lat.

a) "Michael Sars". St. 7, 10, 11, 12, 17, 18, 31.¹ Autumn 1905. (Septbr. 25, Novbr. 16). Large Herrings ("Storsild") of an average length of 29—30 cm and of maturity III.

Vert. S.		Precaudal Vert.		K 2	
Number	Frequency	Number	Frequency	Number	Frequency
56	6	22	1	12	1
57	40	23	10	13	17
58	23	24	26	14	39
59	3	25	28	15	13
..	..	26	6	16	1
..	..	27	1	17	1
<i>n</i>	72		72		72
<i>m</i>	57.32		24.43		13.99
σ	0.69		0.93		0.81
σ_m	0.081		0.11		0.096
σ_σ	0.057		0.078		0.068

b) "Michael Sars" St. 13. October 6. 1905. Maturity I—II (a few III). Length 178—285 mm, average 238 mm. Fat Herrings ("Fedsild").

Vert. S.		Precaudal Vert.		K 2		Rays in ventr. fins	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
56	1	23	1	12	1	17	3
57	21	24	17	13	9	18	36
58	19	25	19	14	26	19	1
..	..	26	4	15	5	20	1
<i>n</i>	41		41		41		41
<i>m</i>	57.44		24.63		13.85		18.00
σ	0.55		0.70		0.65		0.45
σ_m	0.096		0.11		0.10		0.070
σ_σ	0.061		0.087		0.072		0.049

c) "Michael Sars" St. 18. October 21. 1905. Maturity I—II. Length 200—256 mm, average 232 mm. Fat herrings ("Fedsild").

Vert. S.		Precaudal Vert.		K 2		Rays in ventr. fins	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
56	2	23	1	13	11	15	1
57	17	24	10	14	14	16	..
58	10	25	13	15	4	17	3
59	1	26	4	16	1	18	26
..	..	27	2	..	..	..	..
<i>n</i>	30		30		30		30
<i>m</i>	57.33		24.87		13.83		17.80
σ	0.66		0.94		0.79		0.61
σ_m	0.12		0.17		0.14		0.11
σ_σ	0.085		0.12		0.10		0.079

¹ A material of ca. 40 herrings of maturity III from "Michael Sars" St. 13 is omitted here, as BROCH's calculations p. 68 and his graphical figures pl. VIII are not in accordance with each other. (HJ. BROCH: Norwegische Heringsuntersuchungen während der Jahre 1900—1906. Bergens Museums Aarbog 1908).

b og c) The preceding two samples put together. "Michael Sars" St. 13 & 18 1905. Fat Herrings ("Fedsild").

Vert. S.		Precaudal Vert.		K 2		Rays in ventr. fins	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
56	3	23	2	12	1	15	1
57	38	24	27	13	20	16	..
58	29	25	32	14	40	17	6
59	1	26	8	15	9	18	62
..	..	27	2	16	1	19	1
..	..	..	..	..	..	20	1
<i>n</i>	71		71		71		71
<i>m</i>	57.39		24.73		13.84		17.92
σ	0.60		0.81		0.71		0.53
σ_m	0.071		0.096		0.084		0.063
σ_σ	0.050		0.068		0.060		0.044

Træna Bank and Træna Deep. "Michael Sars". Autumn 1905.

All the samples before mentioned (under a, b and c) put together, viz. Large Herrings ("Storsild") of Maturity III from the Stations 7, 10, 11, 12, 17, 18 and 31 and Fat Herrings ("Fedsild") from the Stations 13 and 18.

Vert. S.		Precaudal Vert.		K 2		Rays in ventr. fins	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
56	9	22	1	12	2	15	1
57	78	23	12	13	37	16	..
58	52	24	53	14	79	17	6
59	4	25	60	15	22	18	62
..	..	26	14	16	2	19	1
..	..	27	3	17	1	20	1
<i>n</i>	143		143		143		71
<i>m</i>	57.36		24.58		13.92		17.92
σ	0.64		0.79		0.76		0.53
σ_m	0.054		0.066		0.064		0.063
σ_σ	0.038		0.047		0.045		0.044

From the Nordland District: (Sklinna Bank and Træna Bank etc.) BROCH has, as stated above, analysed 173 Large Herrings ("Storsild") and Fat Herrings ("Fedsild"). Are these analyses put together, we get the following result:

Vert. S.		Precaudal Vert.		K 2		Rays in ventr. fins	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
56	11	22	1	12	2	15	1
57	94	23	17	13	49	16	..
58	63	24	62	14	91	17	6
59	5	25	74	15	26	18	62
..	..	26	16	16	4	19	1
..	..	27	3	17	1	20	1
<i>n</i>	173		173		173		71
<i>m</i>	57.36		24.55		13.91		17.92
σ	0.65		0.88		0.79		0.53
σ_m	0.049		0.067		0.060		0.063
σ_σ	0.035		0.038		0.042		0.044

If we compare the examined samples of spring herrings from the southwestern Norway with the Northland herring, we obtain the following result:

Diff. Vert. S.	Spring herring of S. W. Norway minus Nordland herring + 0.20 st. d. of diff. 0.060				
— Precaudal Vert.	—	—	—	—	+ 0.09 — — 0.12
— K 2	—	—	—	—	+ 0.05 — — 0.073
— Ventr. Rays	—	—	—	—	+ 0.05 — — 0.102

In the number of vertebrae we find here a difference of more than 3 times the standard deviation, and in the number of keeled scales a difference of two times the standard deviation.

As will be seen from the survey below a difference with respect to these characters appears in most cases, when we compare the single analyses of spring herrings from the south western with those from the Nordland district.¹

Mean values of Vert. S. and K 2 for spring herrings from the South Norway and the Nordland district.

South western Norway.

Locality	Date	Vert. S.	K 2	No. of specimens
Utsire	Febr. 1888	57.61	..	61
Utsire & Nordvaag	?	..	13.89	9
Haugesund	March 1905	57.67	14.07	70
—	— 1906	57.60	14.07	100
Solsvik	Febr. 1905	57.43	14.30	30
Aalesund	Jan. 1905	57.55	14.19	100
—	— 1906	57.46	13.96	100
Risør, Skagerak	Jan. 13. 1906	57.33	14.22	9
— —	— 18. —	57.60	14.30	10?
— —	— 21. —	57.50	14.30	10?
— —	— 27. —	57.50	13.92	26
— —	March 4. 1907	57.57	..	42

Average: 57.55 (558 spec.) 14.08 (464 spec.)

Nordland-District.

Locality	Date	Vert. S.	K 2	No. of specimens
M. Sars St. 7	Sept. 25. 1905	57.56	13.62	16
— - 8	— 26. —	57.60	14.10	10
— - 9	— 27. —	57.40	14.20	10
— - 10	— 29. —	56.90	14.30	10
— - 11	Oct. 3. —	57.50	14.00	10
— - 12	— 4. —	57.20	14.20	10
— - 13	— 6. —	57.53	13.98	40
— - 13	— 6. —	57.43	13.85	41
— - 17	— 19. —	57.20	13.80	10
— - 18	— 21. —	57.40	13.90	10
— - 18	— 21. —	57.37	13.87	30
— - 19	— 24. —	57.30	13.90	10
— - 22	— 31. —	57.50	13.60	10
— - 24	Nov. 3. —	57.20	13.60	10
— - 31	— 16. —	57.40	14.20	10

Average: 57.40 (237 spec.) 13.93 (237 spec.)

In a following section the probable reason for this difference will be discussed.

If we put together the whole material of Norwegian herrings from the Nordland district, the south western Norway and the Skagerrack, for which detailed analyses are at hand, we get the following result:

¹ Most of the average figures are given here after H. J. BROCH (l. c. 1908). The difference in Vert. S. for the whole material examined is a little less than that stated above, but the standard deviation of the difference will probably also here be less.

Vert. S.		Prec. Vert.		K 2		Ventr. fin-rays	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
56	41	22	1	11	1	15	2
57	291	23	29	12	6	16	3
58	291	24	109	13	103	17	18
59	40	25	124	14	284	18	225
60	2	26	33	15	111	19	1
..	..	27	8	16	7	20	1
..	..	..	..	17	1	..	..
<i>n</i>	665		304		513		250
<i>m</i>	57.50		24.60	~	14.02		17.89
σ	0.72		0.91		0.74		0.45
σ_m	0.028		0.052		0.033		0.028
σ_σ	0.019		0.037		0.023		0.020

As will be mentioned in a following section it is doubtful whether all these herrings belong to one single race.

V. Spring spawning Herrings on the Northsea-Plateau between the Shetland isles and the Norwegian Channel.

HJALMAR BROCH has undertaken a series of analyses of herrings captured in the autumn of 1904 from the "Michael Sars" and the "Kinn", and in autumn of 1905 from the "Fritjof" in the northern part of the North Sea and the adjacent parts of the Norwegian Sea between 60° and 62° N. Lat. and 1°—3° E. Long.

BROCH came by his investigations to the result, that the herrings in this area belong partly to the summer- and autumn spawning Shetland herring and partly to the Norwegian spring herring (l. c. 1908). BROCH divided the herring into two groups according to the state of maturity. One group comprises the stages II—III and III (together with some in stages I and II), and these herrings are fat or moderately fat. The other group comprises the stage VI, which corresponds to my stages VII and VIII (spents and recovering spents). For this stage is generally recorded no fat or fat in small quantities in the ventral cavity. The size of the specimens in stage I varies from ca. 23—26 cm (Fat herring) in the stages II—III and III from 24—32 cm and in stage VI from ca. 26—32 cm.

BROCH has undertaken his analyses in the time from September 5. to November 2. 1904 and from August 12. to October 16. 1905, and he concludes that the specimens of maturity II—III and III are spring spawners, while the specimens of maturity VI are autumn spawners, and this is assuredly right.¹ The result of the analyses show that the herring by this sorting was divided in two different races, at any rate in the main. The one group of herrings has a perceptibly higher number of vertebrae and a perceptibly lower number of keeled scales than the other. The result of the analyses is as follows:

Spring Spawners, Maturity II—III, III (IV).

Station	Date	No. of specimen	Average length cm	Vert. S.	Prec. Vert.	K 2	Maturity
8 ²	12. Sept. 1904	50	30.40	-	57.34	24.18	II—III (IV)
10	14. — —	26	29.58	-	57.23	24.27	II—III (IV)
11	15. — —	34	30.06	-	57.27	24.32	II—III (IV)
Vikingbank	27. Oct. —	12	29.98	-	57.42	24.50	II—III
—	1. Nov. —	10	29.16	-	57.00	24.30	II—III IV
—	2. — —	31	29.69	-	57.42	24.42	III
— St. 21	12. Aug. 1905	10	28.40	-	57.40	24.90	III
— - 22	14. — —	10	28.59	-	57.40	24.30	III
— - 23	15. — —	10	28.39	-	56.60	23.90	III
— - 32	28. Sept. —	9	28.70	-	57.60	24.11	III
— - 33	29. — —	8	29.00	-	57.25	24.88	III
— - 34	20. Oct. —	10	28.90	-	57.00	23.90	III
— - 35	25. — —	10	27.91	-	57.20	24.30	III
— - 36	26. — —	8	28.40	-	57.00	24.50	III
Total: 238			29.08 cm		57.22	24.34	14.11

¹ For the stages I and II the spawning time is unknown.

² As to the central positions of the various stations see HJ. BROCH: *Norwegische Heringsuntersuchungen während der Jahre 1904—1906*. Bergens Museums Aarbog 1908.

Autumn-Spawners. Maturity VI.

Station	Date	No. of spec.	Average length cm	Vert. S.	Prec. Vert.	K 2	Maturity
9	Sept. 13, 1904	32	30.66	-	56.94	23.59	14.41 (V) VI, (II—III)
Vikingbank	Oct. 14. —	60	30.65	-	56.62	23.73	14.39 VI
—	— 27. —	16	30.21	-	56.63	23.31	14.25 VI
—	Nov. 1. —	20	29.36	-	56.65	23.60	14.60 VI
—	— 2. —	2	30.95	-	58.00	24.00	14.50 VI
32	Sept. 28, 1905	1	28.80	-	57.00	24.00	14.00 VI
33	— 29. —	2	29.30	-	57.00	24.00	13.50 VI
36	Oct. 26. —	2	30.35	-	56.50	23.00	14.50 VI
Total: 135			30.38 cm	56.73	23.63	14.40	

Detailed analyses for the spring spawning herrings are given for Vikingbank for Oct. 27. to November 2. 1904 and for August 12. to October 26, 1905 with the following result:

Vikingbank. The North Sea W. of the Norwegian Channel. Date of capture Oct. 27. to Nov. 2. 1904. "Kinn".

A. Spring spawners. 53 spec. Maturity II—III. Length 268—336 mm.

Vert. S.		Prec. Vert.		K 2		Rays in ventr. fins.	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
55	1	22	1	13	12	16	1
56	2	23	5	14	28	17	4
57	30	24	23	15	11	18	47
58	18	25	19	16	2	19	..
59	2	26	5	..	..	20	1
<i>n</i>	53		53		53		53
<i>m</i>	57.34		24.42		14.06		17.92
σ	0.72		0.86		0.77		0.47
σ_m	0.10		0.12		0.11		0.07
σ_σ	0.07		0.084		0.07		0.05

B. Autumn-spawners. 38 specimens. Maturity VI (Brochs scale). Length 277—321 mm.

Vert. S.		Prec. Vert.		K 2		Rays in ventr. fins.	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
55	1	22	4	13	3	15	1
56	15	23	14	14	18	16	3
57	18	24	17	15	15	17	1
58	3	25	3	16	1	18	32
59	..	..	..	17	1	19	1
60	1	..	..	..	..	..	..
<i>n</i>	38		38		38		38
<i>m</i>	56.71		23.50		14.45		17.76
σ	0.87		0.80		0.85		0.75
σ_m	0.14		0.13		0.13		0.12
σ_σ	0.10		0.09		0.09		0.09

Vikingbank. August-October 1905. "Fritjof". Spring-spawners. Maturity III.

Vert. S.		Prec. Vert.		K 2		Ventr. fin-rays	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
55	1	23	11	13	12	17	3
56	9	24	36	14	46	18	22
57	42	25	20	15	14	..	..
58	22	26	8	16	3	..	..
59	1	..	..	..	..	..	..
<i>n</i>	75		75		75		25
<i>m</i>	57.17		24.33		14.11		17.88
σ	0.70		0.86		0.71		0.33
σ_m	0.081		0.099		0.082		0.066
σ_σ	0.058		0.070		0.058		0.047

Vikingbank 1904 and 1905. The preceding samples of spring-spawners put together.

Vert. S.		Prec. Vert.		K 2		Ventr. fin-rays	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
55	2	22	1	13	24	16	1
56	11	23	16	14	74	17	7
57	72	24	59	15	25	18	69
58	40	25	39	16	5	19	..
59	3	26	13	..	..	20	1
<i>n</i>	128		128	~	128		78
<i>m</i>	57.24		24.37		14.09		17.91
σ	0.71		0.86		0.73		0.43
σ_m	0.063		0.076		0.065		0.049
σ_σ	0.044		0.054		0.046		0.035

BROCH states, as mentioned before, the autumn spawning herring from the said area to be the Shetland herring, while he considers the spring spawning herring as identical with the large Norwegian spring herring. We shall here regard this last result more closely.

For 238 spring herrings from the North Sea plateau the mean value of the vertebrae (Vert. S.) is 57.22. According to the special analyses recorded on page 22 the standard deviation of the mean value may be estimated to 0.04 à 0.05; it will be seen on page 16 that the analyses of 461 mature southwest Norwegian spring herrings have shown, that the mean value of vertebrae was 57.56 with a standard deviation of 0.034. If we compare these two mean values, we obtain a difference of 0.34 with a standard deviation of the difference of ca. 0.05. Thus we find here a real difference in the number of vertebrae.

Even if we take only the 128 spring herrings from the North Sea plateau, of which special analyses are recorded (p. 22) as a basis for comparison with the south west Norwegian spring herring, a real difference in the number of vertebrae appears, as will be seen from the figures below:

Diff. Vert. S.	S.W. Norwegian spring herring minus Vikingbank	+ 0.32	standard deviation of diff.	0.072
— Prec. Vert.	— — — — —	+ 0.27	— — — —	0.122
— K 2	— — — — —	÷ 0.03	— — — —	0.077
— vent. rays	— — — — —	÷ 0.04	— — — —	0.061

A real difference between the spring herring from the North Sea plateau and the herring from the Norwegian Nordland district can not be pointed out on the basis of the material at hand (see the survey below), but in all probability this is only due to the circumstance that the material investigated as far as yet is too small. A consideration of all the mean values of the vertebrae and keeled scales of the herrings from the two areas hardly allows us to doubt that the difference will prove to be of importance.

Diff. Vert. S.	Nordland herring minus Vikingbank etc.	+ 0.12	standard deviation of diff.	0.080
— Prec. Vert.	— — — — —	+ 0.18	— — — —	0.101
— K 2	— — — — —	÷ 0.18	— — — —	0.088
— ventr. rays	— — — — —	+ 0.01	— — — —	0.080

If we compare the spring herring from the North Sea plateau with all the investigated Norwegian spring herrings from the Skagerrack, the south-western Norway and the Nordland district together, a real difference in the number of vertebrae appears, as will be seen from the figures below

Diff. Vert. S.	Norwegian spring herring minus Vikingbank	+ 0.26	standard deviation of diff.	0.069
— Prec. Vert.	— — — — —	+ 0.23	— — — —	0.092
— K 2	— — — — —	÷ 0.07	— — — —	0.073
— Ventr. rays	— — — — —	÷ 0.02	— — — —	0.056

The difference in Vert. S. is here 4 times as great as the standard deviation of the difference.

To this comes that some age analyses, which LEA has undertaken of spring spawning herrings captured in the North Sea plateau, at an age of 10—15 years, showed a considerably smaller average size than the Norwegian spring herring of the same age. The difference in size is here ca. 4 cm. This will be seen from the figures below compared with the survey on page 28.

Age analyses of spring spawning herrings (Maturity, as a rule III, III—IV or IV) captured in autumn in the North Sea plateau, according to LEA (JOHAN HJORT l. c. 1910):

Datum	Locality	Age	Average length cm	No. of specimens
Sept. 16. 1909	66°30' N. 3°30' E.	9 ¹ / ₂	30.5	22
		10 ¹ / ₂	30.3	25
		11 ¹ / ₂	29.0	17
		12 ¹ / ₂	29.0	3
		[13 ¹ / ₂	30.0	1]
		[14 ¹ / ₂	30.0	1]
Oct. 11. 1909	60°32' N. 2°50' E.	9 ¹ / ₂	30.1	7
		10 ¹ / ₂	30.7	9
		11 ¹ / ₂	30.0	2
		12 ¹ / ₂	30.7	3
		13 ¹ / ₂	30.7	3
		14 ¹ / ₂	30.5	2

BROCHS opinion that the spring herrings from the North Sea plateau as a whole are Norwegian spring herrings thus evidently is not right, but the possibility cannot be excluded that the samples have contained elements of this herring. About this we know nothing at present.

As it will be seen from the survey below the spring herring from the North Sea plateau deviates significantly from the herrings examined from Iceland and the Faroes, by the number of keeled scales (K 2). The difference is here three times the standard deviation of the difference.

Diff. Vert. S.	Kongshavn	Faroes	minus	Vikingbank	+	0.23	Standard deviation of diff.	0.080
— Prec. Vert.	—	—	—	—	+	0.07	—	0.099
— K 2	—	—	—	—	÷	0.24	—	0.081
— ventr. rays	—	—	—	—	÷	0.05	—	0.059
Diff. Vert. S.	N. Iceland	minus	Vikingbank	+	0.12	Standard deviation of diff.	0.081	
— Prec. Vert.	—	—	—	+	0.04	—	—	0.097
— K 2	—	—	—	÷	0.25	—	—	0.084
— ventral rays	—	—	—	+	0.02	—	—	0.063

Thus there is hardly any doubt that at least an essential part of the spring herrings from the North Sea plateau belongs to another race than the Herrings hitherto mentioned.

Where this other race has its spawning places is not known. The few analyses at hand of the Scottish spring herring suggest, that this has not as high a number of vertebrae as the spring herring from the North Sea plateau. (See Table I p. 34), and that it is of a less average size. It is more probable that the investigated spring herrings from the North Sea plateau on the whole or for an essential part are off-shoot of the spring spawning Shetland herring. Nothing definitely can however be said about this until detailed analyses of the spawning specimens of this last named herring are at hand.

According to some age-analyses which LEA has given of the Shetland spring herring caught in February of 1909, this herring is also smaller than the Norwegian spring herring. LEA's age analyses have given the following result (HJORT l. c. 1918 p. 141):

179 herrings caught in drift-nets, 12 miles of Baltasound 13—2—1909.

Year class	1906	1905	1904	1903	1902	1901	1900	1899
Number of indiv.....	5	7	18	83	38	13	7	8
— — — in %....	2.8	3.9	10.0	46.4	21.2	7.3	3.9	4.5
Average length cm	26.4	26.7	28.9	30.0	30.2	30.4	32.0	31.6

These analyses suggest, that the Shetland spring herring is somewhat smaller than the Norwegian spring herring although a rather large herring. The size of the old specimens of ca. 10 years is about the same as that of herrings of the same age from the North Sea plateau which were investigated by LEA (see p. 24).

It will be seen that the year class 1904 does not play any especially prominent rôle here as in most of the contemporary samples of Norwegian spring herrings.

LEA's investigations comprised 179 specimens of a length from 26—33 cm. They were practically all full grown fish of maturity IV or V, as a rule V. Only a single specimen was spent. According to DUTHIE¹ spent herrings occur at the Shetland isles in May. The main spawning time appears to be March—April.

Though the Shetland spring herring is not without importance for the large Shetland herring fisheries, it signifies undoubtedly far less than the autumn spawning Shetland herring. The herring fishery at the Shetland isles reaches its maximum in the months June to September, or just in the period when the spawning of the autumn herring takes place.

It is probable that the Norwegian as well as the Shetlandic spring herring yields a contingent to the stock of fat herrings and large herrings which occur at the North Sea plateau between the Shetland isles and Norway, and it is obvious, that several of the investigated samples resemble the Norwegian spring herring far more than other samples. The value of the standard deviation for the examined characters of the herring from the North Sea plateau, of which detailed investigations are at hand, is not higher than usually in herrings belonging to the same race.

VI. On the relation between the Icelandic spring herring, the Norwegian Nordland herring, and the south-west Norwegian spring herring.

A comparison between the above mentioned analyses of Icelandic and Norwegian spring herrings shows that these herrings resemble each other very much, and also the examined sample of fat herrings from the Faroe islands comes very near to the Icelandic and Norwegian spring herring.

If we compare the analyses from Eyjafjord (Iceland) and from the Norwegian Nordland area (large herrings plus fat herrings) we obtain the following result:

Diff. Vert. S.	Icelandic (Eyjafjord) herring minus Nordland herring						0.00	st. d. of diff.	0.071
— Prec. vert.	—	—	—	—	—	—	÷ 0.14	—	— 0.091
— K 2	—	—	—	—	—	—	÷ 0.07	—	— 0.080
— Ventr. rays	—	—	—	—	—	—	+ 0.01	—	— 0.075

The difference is here for the three characters less than the standard deviation of the difference, and for the one character (precaudal vert.) ca. 1.5 times as great as the standard deviation.

If we compare the analyses from Kongshavn on the Faroe islands with analyses from the Norwegian Nordland area, we obtain the following result:

Diff. Vert. S.	Faroe herring minus Nordland herring						+ 0.11	st. d. of diff.	0.069
— Prec. vert.	—	—	—	—	—	—	÷ 0.11	—	— 0.093
— K 2	—	—	—	—	—	—	÷ 0.06	—	— 0.077
— Ventr. rays	—	—	—	—	—	—	÷ 0.06	—	— 0.071

The standard deviation of the difference is here for Vert. S. ca. 1.5 times as great as the difference, and for the other characters approximately of the same size as the difference itself.

¹ ROBERT DUTHIE: The fisheries of Shetland. X. Ann. Report Fishery Board for Scotland for 1891. Edinburgh 1892
Fiskeri. V. 8.

When we regard the spring herring from more southern localities at the coasts of Norway between Haugesund and Aalesund, we find that its number of vertebrae as well as its number of keeled scales is a little higher than that of the Icelandic and the Faroese herring, as it will be seen from the surveys below:

Diff. Vert. S.	Spring herring of S. W. Norway minus Icelandic herring, Eyjafjord							+ 0.20	st. d. of diff.	0.062
— Prec. vert.	—	—	—	—	—	—	—	+ 0.23	—	0.11
— K 2	—	—	—	—	—	—	—	+ 0.22	—	0.067
— Ventr. rays	—	—	—	—	—	—	—	+ 0.06	—	0.089

In the number of Vert. S. and keeled scales we find here a difference of more than 3 times the standard deviation.

Diff. Vert. S.	Spring herring S. W. Norway minus Faroe herring							+ 0.09	st. d. of diff.	0.060
— Prec. vert.	—	—	—	—	—	—	—	+ 0.20	—	0.11
— K 2	—	—	—	—	—	—	—	+ 0.21	—	0.063
— Ventr. rays	—	—	—	—	—	—	—	+ 0.01	—	0.087

In the number of Vert. S. and of precaudal vert. there is here a difference of $1\frac{1}{2}$ to 2 times the standard deviation and in the number of keeled scales the difference is more than 3 times the standard deviation.

From the statements given here it will be seen, that we have not been able to substantiate a real difference in the number of vertebrae, keeled scales and ventral fin rays in the following herrings:

1. Icelandic large herrings from Eyjafjord.
2. Faroese fat herrings from Kongshavn.
3. Norwegian large herrings and fat herrings from the Nordland area.

Between the two first named groups on one side and the mature South Norwegian spring herring on the other side we have found a slight difference partly with regard to the total number of vertebrae, partly with regard to the keeled scales (K 2).

What in the first instance catches our eyes by the quoted comparisons is the great similarity between all the investigated spring herrings from Iceland, the coasts of the Faroes and Norway. This similarity may probably partly be explained in this way, that certain important physical conditions, e. g. the temperature, are rather uniform in the places, where the herring from these different areas have their spawning places, partly it may be owing to the circumstance that the herring to a certain extent migrate from one area to another. The Icelandic spring herring as well as the large Norwegian spring herring have their spawning time at the beginning of spring, in March—April, and as spawning places they seek the warmest areas of the coasts in question. The Norwegian spring herring spawns mainly on the stretch from Flaekkefjord to Aalesund (Fig. 10) and probably inside the interval from 0—100 fathoms. The temperature of the water is here in March—April ca. 3—6° C. The Icelandic spring herring spawns chiefly at the western and southwestern coasts of Iceland. It is not elucidated at which depth it deposits its eggs, but the question is probably of a depth within 0—100 fms., where the temperature in March—April is ca. 2—6° C.,¹ or almost the same as that on the spawning places for the Norwegian Spring Herring.

The fat herrings as well as the large herrings at the coasts of Iceland and Norway move far about, and in summer they seek to a great extent areas where it is colder than in the spawning places.

The information procured by HJORT² concerning the distribution of the herring in the Norwegian Sea speaks in no way against the supposition that the herring to a certain extent migrate from one of these areas to another. On the whole stretch, so to speak, from the North Sea coast of Norway across the Faroe Islands to Iceland herrings have been found in larger or smaller quantities. For instance, 365 herrings of a length of 29—35 cm were captured in drift-net in the surface at "Michael Sars" Station 2

¹ As to the surface temperature see the Danish Nautical meteorological Annual.

² JOHAN HJORT: Norsk Havfiske. Norges Fiskerier I. Udgivet af Selskabet for de norske Fiskeriers Fremme. Bergen 1905.

on July 25, 1900 at 63°53' N. 7°15' E., depth 1072 fathoms. During the Norwegian investigations N. E. of the Faroe islands, herrings were often taken in the stomach of cod, halibut, *Macrurus* and *Molva byrkelange*, which were captured at depths exceeding 200 fathoms. This suggests that the herring has here a great vertical distribution. According to HJORT it is a common experience, which the Norwegian fishermen have made, that herrings are found in the ling (*Molva molva*) which is captured at ca. 200 fathoms' depth. HJORT's pointing out that herring may occur in the Norwegian Sea midway between Norway and Jan Mayen is very interesting. At St. 26 on June 19, 1901 at 69°37' N. and 25°8' E. and 240 miles from shore, 5 herrings of a length of 28, 28, 29, 32 and 33 cm, were captured in drift-nets from the sailing cutter "Mira". Among these the two smallest were fat herrings, the three largest blood herrings.

The fact that blood herrings occurred here, prove that it is not solely the young herrings which undertake very long migrations, but that the grown-up herrings also after the spawning may move very far about.¹ The time for the capture of the blood herrings shows that the question is here about spring spawning herrings.

As a point of resemblance between the Icelandic herring, the Norwegian Nordland herring and the south-west Norwegian spring herring it can also be pointed out that they, at the age of 10—15 years, when the growth approaches its end, are all practically of the same average length: ca. 34—36 cm.

In the comparison of the size I use mainly the material procured by HJORT and LEA.² This does not mean, however, that I think, we by means of the winter rings in the scales are able to determine with exactness the age of the older specimens. According to my opinion we must here be satisfied with approximate determinations. As the yearly growth, however, is very insignificant at the age from 10—15 years, it makes no difference in this connection if we often make a mistake of a few years in determining the age.

The difference in size between males and females is so inconsiderable that there is no reason to separate the two sexes by a comparison as that below.

In the comparison we must lay particular stress on the samples where the specimens of the older annual series are numerous represented. If we regard samples where the younger annual series are quite predominating and where only a few specimens of the older series occur, these older specimens will as rule be of a size which lies far below the average size for the year class in question.

Average sizes of the Icelandic and Norwegian Spring herring of the age of ca. 10—15 years:

Icelandic Spring Herring. ³				
Date	Place	Age	Average length cm	No. of specimens
July 25, 1908	Siglunæs, N. Iceland (LEA)	9 ¹ / ₄	35.6	95
		10 ¹ / ₄	36.3	74
		11 ¹ / ₄	36.3	40
		12 ¹ / ₄	36.7	31
		13 ¹ / ₄	36.8	24
		14 ¹ / ₄	36.7	10

¹ As is well known the herring spawns only in shallow water.

² JOHAN HJORT: Report on Herring-Investigations until January 1910. Publications de Circonstance No. 53. Copenhagen 1910.

³ In a similar way it will be found that the specimens of the youngest, not abundantly represented, annual group in a sample are of a size which much surpasses the average of the year group in question.

⁴ The summer spawning herring at Iceland seems according to LEA's investigations to reach about the same size as those spawning in spring.

Icelandic Summer Herring.				
Date	Place	Age	Average length cm	No. of specimens
June 3, 1918	Faxebay 64°20' N. 23°40' W.	10	36.2	47
		11	36.5	20
		12	36.1	8
		13	36.9	8
		14	36.9	10

Date	Place	Age	Average length cm	No. of specimens
Sept. 1909	North Iceland (LEA)	9 $\frac{1}{2}$	35.5	9
		10 $\frac{1}{2}$	35.1	25
		11 $\frac{1}{2}$	35.6	27
		12 $\frac{1}{2}$	36.0	30
		13 $\frac{1}{2}$	36.2	20
		14 $\frac{1}{2}$	36.8	16
Sept. 1915	Eyjafjord (A. C. JOHANSEN)	15 $\frac{1}{2}$	36.1	11
		c. 9—15	34.1	62

Norwegian Nordland Herring (Spring Herring).

Date	Place	Age	Average length cm	No. of specimens
Autumn 1907	66°18' N. 10°40' E. (LEA)	9 $\frac{1}{2}$	33.2	10
		10 $\frac{1}{2}$	34.8	5
		11 $\frac{1}{2}$	35.3	8
		12 $\frac{1}{2}$	35.0	5
		13 $\frac{1}{2}$	35.4	5

South-Norwegian Spring Herring.

Date	Place	Age	Average length cm	No. of specimens
December 16. 1908	Kristianssund (LEA)	9 $\frac{3}{4}$	32.7	6
		[10 $\frac{3}{4}$	33.0	3]
		[13 $\frac{3}{4}$	37.0	1]
March 11. 1907	Bømmelø ca. 59°40' N. (LEA)	9	31.9	8
		11	34.8	4
		[13	35.0	1]
		[14	36.0	1]
February 1908	Föina (LEA)	9	32.9	15
		10	33.2	5
		11	34.8	4
		[12	37.0	1]
		[13	36.5	2]
March 11.—12. 1907	Haugesund (DAHL) ¹	[14	35.5	2]
		9	32.8	31
		10	34.6	21
		11	35.0	16
		12	35.05	20
		13	35.5	8
February 26. 1909	Kalvaag (LEA)	14	35.0	5
		10	32.4	7
		11	34.0	3
		12	35.5	3
		13	36.8	4
		[15	34.0	1]

According to LEA's investigations the year classes of 1899 and especially of 1904 were exceedingly abundantly represented in the captures of the Norwegian spring herring from the Nordland area as well as from the southern Norway. At the coasts of Iceland the year class of 1899 was also according to LEA predominately amply represented as well as the year class of 1898. If the year class of 1904 has been especially amply represented at the coasts of Iceland, is not known, as sufficient investigations are not at hand.

With regard to the differences found between the Icelandic spring herring and the south-west Norwegian spring herring I think it probable that they are due to certain average differences

¹ KNUT DAHL: The scales of the herring. Report on Norwegian Fishery and Marine-Investigations. Vol. 11. 1907. No. 6. Bergen. 1907.

in the conditions of nature at the spawning places for the two groups of herrings.¹ By mixture of elements of the two groups the differences may become more or less effaced.

We do not know, however, as far as yet, if we shall always be able to distinguish the herrings developed at the south-western coasts of Norway from the herrings developed at the coasts of Iceland. It is possible that there is a rather considerable oscillation in the examined characters within each of these groups, so that the mean values of the characters examined are not quite equal at all localities in the same years and not quite equal either on the same locality in different years.

The differences found between the Norwegian Nordland herring and the south-west Norwegian spring herring may be explained in different ways. Future investigations may enable us to see which explanation be the right one.

First Possibility.

The differences found between the herrings from the Nordland coasts of Norway and the spring herrings from the S. W. coasts of Norway may be owing to the circumstance that the herrings first mentioned, which were examined as fat herrings or large herrings, have not been unmixed large spring herrings, but have contained elements of local races with a lower number of vertebrae and a lower number of keeled scales.

As mentioned before HJ. BROCH has shown, that in certain of the Norwegian fiords, as the Trondhjemsfjord and Beistadfjord, local herring races occur with a lower number of vertebrae and keeled scales than we find in the S. W. Norwegian spring herring.² These local herring forms, however, deviate so considerably from the S. W. Norwegian spring herring in the total number of vertebrae (Vert. S.) that a mixed sample of those and the S. W. Norwegian spring herring by the analyses and calculation of the standard deviation would probably give a higher value for σ than that found for the Nordland herring. The analyses of this herring have constantly shown an equally low value of σ for Vert. S. as analyses of the mature spring herring (see p. 17—19 and Table I). A concrete example will elucidate this matter further.

BROCH's analyses of the herring from Beistadfjord have given the following result:

Beistadfjord. April 1905. 100 specimens. Maturity I—V. Length 201—262 mm. Average 221 mm.

Vert. S.		Pecaudal Vert.		K 2		Rays in ventr. fins	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
53	1	22	1	12	4	15	2
54	1	23	23	13	41	16	2
55	3	24	45	14	48	17	6
56	38	25	26	15	7	18	90
57	51	26	5	..	..	..	..
58	6	..	..	..	..	..	..
n	100		100		100		100

¹ HEINCKE considered the Icelandic herring as a particular race which is distinctly separated from the large Norwegian spring herring. He indicates the following differences between them (Naturgeschichte des Herings. Abhandlungen des deutschen Seefischerei-Vereins Bd. II. Berlin 1898).

Icelandic herring.	Norwegian large spring herring.
1. the tail rather long.	tail short.
2. the snout very short.	the snout rather long.
3. the eyes exceedingly large.	the eyes small.
4. the craniums length—breath index large, in mean value 31, thus <i>brachycephal</i> .	the craniums length—breath index rather small (c. 30) thus <i>mesodolichocephal</i> .

The material which HEINCKE has disposed of with regard to the Icelandic herring, is however not sufficient to form a basis for such extensive conclusions. His analyses comprise only 24 full grown specimens from an unknown place of capture, and with an unknown spawning time. To this comes, that the characters mentioned are subjected to changes during the development and growth of the specimens, and that the extent of these changes is not known as yet.

² In Danish waters we also notice that the fjord-herrings as a rule have a lower number of vertebrae and keeled scales than the herrings in the adjacent open seas. With regard to *Zoarces* DR. JOHNS. SCHMIDT has found that the number of vertebrae, hard rays and pigment spots as a rule is lower in the fjords than outside (JOHNS. SCHMIDT: Racial Investigations I. *Zoarces viviparus* L. and local races of the same. — Comptes-rendus des travaux du Laboratoire de Carlsberg. 13me Volume. 1917).

m	56.55	24.11	13.58	17.84
σ	0.78	0.85	0.68	0.55
σ_m	0.078	0.085	0.068	0.055
σ_σ	0.055	0.060	0.048	0.039

If we now mix these 100 herrings from Beistadford with the 461 examined spring herrings from the S. W. Norway (mentioned on p. 16) we obtain the following result for Vert. S.

Vert S.			
53	1	m	57.38
54	1	σ	0.84
55	3	σ_m	0.035
56	66	σ_σ	0.025
57	236		
58	218		
59	34		
60	2		
n	561		

It will be seen that σ has here an extraordinary high value in proportion to the value which it has in the separate elements of the mixture, and in the examined samples of the Nordland herrings.¹

Second Possibility.

The relatively high number of vertebrae and keeled scales (K2) found in the south west Norwegian spring herring is possibly not a constant character for all year classes. There may be a difference between the various year classes, e. g. in consequence of differences in certain hydrographical factors during the development of the fry.²

Third Possibility.

The differences found between the spring herring from the south-western Norway and the Norwegian Nordland herring may be owing to the circumstance that there is an average difference in the conditions of nature in the places; where these herrings have their spawning places. In that case the difference may have been fixed through inheritance.

¹ We have far more reason to suppose that the herrings from Trondhjemsfjord, which BROCH has investigated, is a mixture either of two local forms or of a local form and young herrings of the large Norwegian spring herring. As it will be seen from the survey below σ has here for the characters examined, especially for Vert. S., a peculiar high value.

Trondhjemsfjord, Aug. 31. 1905. 59 specimens. Length 175—253 mm (Average 214 mm). Maturity I—III (Hj. BROCH).

Vert. S.		Precaudal Vert.		K 2		Rays in Vertr. fins	
Number	Frequency	Number	Frequency	Number	Frequency	Number	Frequency
55	3	22	1	11	1	16	2
56	15	23	10	12	1	17	4
57	26	24	18	13	20	18	53
58	11	25	22	14	25	..	..
59	4	26	8	15	11	..	..
..	..	..	..	16	1	..	..
n	59		59		59		59
m	57.97		24.44		13.80		17.86
σ	0.96		0.99		0.89		0.43
σ_m	0.126		0.013		0.115		0.056
σ_σ	0.089		0.009		0.082		0.040

² It has been shown by Dr. JOHNS. SCHMIDT that the number of dorsal fin-rays in broods of the same parents of the South American Cyprinodont *Lebistes reticulatus* Regan can be influenced by temperature (JOHNS. SCHMIDT: Racial Investigations II. Comptes-Rendus des travaux du Laboratoire de Carlsberg. 14me Vol. No. 1. Copenhagen 1917).

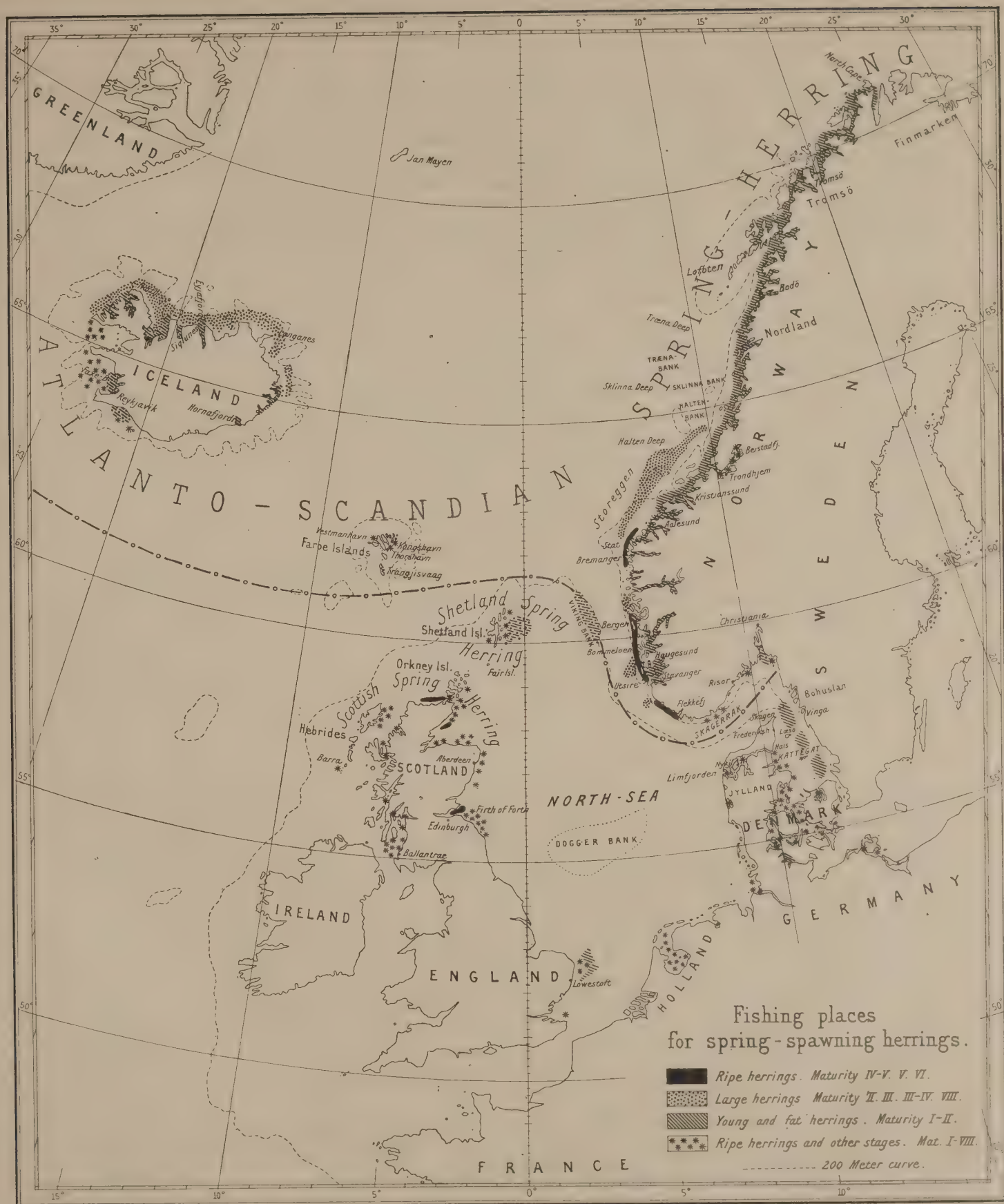


Fig. 10.

If the difference found between the Nordland herring and the south-west Norwegian herring must be explained in this way, it is probable that the Nordland herring chiefly spawns in the northern and colder part of the spawning area of the herring at the coasts of Norway, perhaps between Bremanger and the Trondhjemsfjord, while the south-west Norwegian spring herring in preference spawns in a more southern and warmer area, about Haugesund and Bergen etc.

In this connexion it is interesting to regard THOR IVERSEN's chart¹ of the areas where the fishery after the spawning spring herring at the coasts of Norway takes place. According to this chart the main fishing grounds lie partly in a northern area about Bremanger and Stat, partly in two more southern areas (Flaekkefjord-Stavanger and Stavanger-Haugesund-Bergen). This chart of THOR IVERSEN has been the basis for the representation of the fishing areas in Fig. 10 as far as the Norwegian west-coast is concerned.²

It deserves here to be mentioned, that one of the examined samples of herrings from Aalesund (Jan. 1906) in the investigated characters (Vert. S. and K2) resembles the Nordland herring far more than the other investigated spring herrings from the south-western Norway (See p. 16).

It is probable, that the fat herrings and the large herrings from both the northern and southern spawning grounds occur in summer essentially north of the spawning grounds, e. g. in the Nordland district. The Nordland herring may originate from both groups of spawning places. Thus there is a possibility, that the difference between the herrings spawning on the northern spawning areas and the herrings spawning on the southern spawning grounds, is greater, than the difference we find between the Nordland herring and the south-west Norwegian spring herring, as the first named may have been a mixture of two different races.

The circumstance that the Icelandic spring herring resembles the Nordland herring more than the South-Norwegian herring may indicate more similarity in the outer conditions in the spawning places of the Icelandic herring and the Nordland herring than in the spawning places of the Icelandic herring and the south west Norwegian herring

Fourth Possibility.

The differences previously mentioned between the Norwegian Nordland herring and the south-west Norwegian spring herring may be racial differences, which have their roots in the past, and to the origin of which the causes are unknown. This possibility is, however, in the present case very far off.

VII. Concluding remarks.

As it will be seen from the facts mentioned above the large spring herrings from Iceland, the Nordland coasts of Norway and the south-west coasts of Norway stand very close to each other. Opposite to all other herrings they deserve to be regarded together as a unit. It is the largest spring-spawning form known of *Clupea harengus*, and it is distinguished in comparison with all other herrings hitherto known by a very high average number of vertebrae combined with a relatively small number of keeled scales (K2). It is thus natural to have a common designation for this group of herrings. I propose the name: The Atlanto-Scandian Spring Herring. This herring has extensive spawning places at the south coast and west coast of Iceland and at the coast of the southern part of Norway. It is not known, if this herring also spawns at the Faroe islands, but young herrings and fat herrings, which belong to the same group, occur at any rate at the Faroe islands.

The "racial characters" or distinguishing marks of the spring spawning Shetland herring are not known as yet, but already at Scotland, Bohuslän in Sweden, Kattegat and the northern Jutland the spring herrings are smaller forms than the Atlanto-Scandian Spring Herring, and they differ also from this by a smaller number of vertebrae and as a rule by a higher number of keeled scales. This will be seen from Table I.

¹ THOR IVERSEN: Om en subvenert ferskfiskrute. Aarsberetning vedk. Norges Fiskerier for 1915.

² For Scotland and the North Sea the representation of the fishing places on Fig. 10 is based on papers of FULTON, KYLE, HEINCKE, HJ. BROCH, DELSMAN and REDEKE, but the information at hand is here rather incomplete. — I am indebted to Dr. E. KOEFOED for information as to the herring fishing in the south-west Norwegian Fjords.

The spring spawning herrings in the great waters between Norway and Iceland and around Iceland and the Faroes are far more uniform than the spring spawning herrings in the small waters Kattegat and the Western Baltic. The probable explanation of this fact is that some of the principal hydrographical factors are more uniform and has for a long period been more uniform on the spawning places in the first named areas than in the last named ones. In the Kattegat and Western Baltic the salinity at the spawning places for the spring spawning herrings varies so much as from ca. 10 to ca. 30 ‰, and the temperature so much as from ca. 2 to 12° C. The differences in the salinity and temperature at the spawning places of the spring spawning herrings at Iceland and Norway are far less, but are not exactly known.

Table I. Comparison between the Atlanto-Scandian Spring Herring and the Spring Herrings at the coasts of Scotland, Bohuslän in Sweden, the northern Jutland, and in the Kattegat and Belt Sea.

(Sammenligning mellem den atlanto-skandiske Foraarsild og Foraarsilden ved Kysterne af Skotland, Bohuslän, nordlige Jylland samt Kattegat og Belthavet).

Locality	Off Eyja fjord North Iceland	Kongshavn The Faroes	Off Nordland Norway	Between Haugesund and Aalesund S.W. coast of Norway	Vikingbank North Sea
Date of capture	Septbr. 1915	10. Septbr. 1915	Septbr.—Nov. 1905	Jan.—March Various years	Autumn 1904 & 1905
Maturity	III, IV, V—VIII	I—II	I, II, III	IV—VI	III
Spawning time	Probably March	..	Probably March	March	..
Size (average in brackets) ..	28—36 (33—34)	20—27	..	24—37	24—32
Investigator	A. C. JOHANSEN	A. C. JOHANSEN	HJ. BROCH	HEINCKE & HJ. BROCH	HJ. BROCH
No. of vertebrae (Vert. S.)	Frequency	Frequency	Frequency	Frequency	Frequency
55	..	2	..	..	2
56	14	12	11	28	11
57	106	99	94	185	72
58	60	93	63	212	40
59	12	10	5	34	3
60	..	..	..	2	..
<i>n</i>	192	216	173	461	128
<i>m</i>	57.36	57.45	57.36	57.56	57.24
σ	0.71	0.714	0.65	0.74	0.71
σ_m	0.051	0.049	0.049	0.034	0.063
σ_σ	0.036	0.034	0.035	0.026	0.044
No. of keeled scales (Ks)	Frequency	Frequency	Frequency	Frequency	Frequency
11	..	..	..	1	..
12	5	2	2	3	..
13	53	62	49	49	24
14	104	120	91	173	74
15	28	30	26	80	25
16	2	2	4	3	5
17	..	..	1	..	..
<i>n</i>	192	216	173	309	128
<i>m</i>	13.84	13.85	13.91	14.06	14.09
σ	0.74	0.693	0.79	0.72	0.73
σ_m	0.053	0.047	0.060	0.041	0.065
σ_σ	0.038	0.033	0.042	0.029	0.046

Locality	{ Ballantrae S. W. Scotland	Barra The Hebrides	Firth of Forth E. Scotland	Bohuslän Sweden	Bohuslän Sweden	N. E. Kattegat W. by S. of Vinga
Date of capture	Febr. 1892	July 7. 1891	Jan. 1892	April 15. 1887	Jan. 1878	Febr. 10. 1915
Maturity	IV—VI	Mostly VII—II	Mostly V & VI	IV—VI	II—III	III—V
Spawning time	..	..	..	April	..	Spring
Size (average in brackets)	23—31 (26)	23—31 (27)	24—29 (27)	18—28 (23)	24—28 (25)	20—27 (23)
Investigator	HEINCKE	HEINCKE	HEINCKE	HEINCKE	HEINCKE	A. C. JOHANSEN
No. of vertebrae (Vert. S.)	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency
54	1	..	..	..	..	1
55	2	..	..	..	..	9
56	5	7	7	12	7	37
57	16	17	21	12	7	11
58	6	6	2	1	..	4
59	..	..	..	..	..	2
<i>n</i>	30	30	30	25	14	64
<i>m</i>	56.80	56.97	56.83	56.56	56.50	56.22
σ	0.96	0.67	0.53	0.58	0.48	0.93
σ_m	0.18	0.12	0.10	0.12	0.13	0.117
σ_σ	0.12	0.09	0.07	0.08	0.09	0.082
No. of keeled scales (Ks)	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency
12	..	1	..	2	..	..
13	7	3	4	5	1	9
14	13	19	15	14	8	33
15	9	6	8	4	4	18
16	1	1	3	..	1	4
<i>n</i>	30	30	30	25	14	64
<i>m</i>	14.13	14.10	14.33	13.80	14.36	14.27
σ	0.82	0.76	0.85	0.82	0.74	0.78
σ_m	0.15	0.14	0.15	0.16	0.20	0.097
σ_σ	0.11	0.10	0.109	0.12	0.14	0.069
Locality	{ N. E. Kattegat Kobbergrund	N. W. Kattegat N. of Skagen	N. W. Kattegat off Frederikshavn	W. Kattegat off Udbyhøj	S. W. Kattegat Aarhus Bay. Hou	Great Belt Mouth of Kalund- borg Fjord
Date of capture	Oct. 23. 1915	March 17. 1915	April 23. 1918	April 26. 1915	March 27. 1915	May 2. 1914
Maturity	II—III	III—IV	II—V	IV—V	III—IV	V
Spawning time	Spring	Spring	May—June	May—June	(Spring)	May—June
Size (average in brackets)	21—25 (23)	20—24 (22)	18—23 ¹	20—28 (24)	20—26 (23)	22—30
Investigator	A. C. JOHANSEN	A. C. JOHANSEN	A. C. JOHANSEN	A. C. JOHANSEN	A. C. JOHANSEN	A. C. JOHANSEN
No. of vertebrae (Vert. S.)	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency
53	..	1	..	..	..	..
54	..	..	7	1	1	1
55	7	5	80	94	13	52
56	28	6	113	159	40	85
57	7	..	11	31	12	23
58	1	..	2	..	..	5
59	..	1	..	..	..	..
<i>n</i>	43	13	213	285	66	166
<i>m</i>	56.05	55.62	55.63	55.77	55.95	55.87
σ	0.66	1.33	0.679	0.63	0.67	0.76
σ_m	0.10	0.37	0.0465	0.0375	0.08	0.59
σ_σ	0.07	0.26	0.0329	0.0266	0.058	0.042

¹ Picked out among the smallest specimens captured.

Locality	N. E. Kattegat Kobbergrund	N. W. Kattegat N. of Skagen	N. W. Kattegat off Frederikshavn	W. Kattegat of Udbyhøj	S. W. Kattegat Aarhus Bay. Hou	Great Belt Mouth of Kalund- borg Fjord
Date of capture	Oct. 23. 1915	March 17. 1915	April 23. 1918	April 26. 1915	March 27. 1915	May 2. 1918
Maturity	II—III	III—IV	II—V	IV—V	III—IV	V
Spawning time	Spring	Spring	May—June	May—June	(Spring)	May—June
Size (average in brackets)	21—25 (23)	20—24 (22)	18—23	20—28 (24)	20—26 (23)	22—30
Investigator	A. C. JOHANSEN	A. C. JOHANSEN	A. C. JOHANSEN	A. C. JOHANSEN	A. C. JOHANSEN	A. C. JOHANSEN
No. of keeled scales (K_2)	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency
12	..	..	..	2	..	..
13	5	2	25	35	7	15
14	17	7	108	149	27	74
15	19	4	71	89	29	64
16	2	..	9	10	3	13
n	43	13	213	285	66	166
m	14.42	14.15	14.300	14.246	14.42	14.45
σ	0.76	0.7	0.729	0.74	0.75	0.77
σ_m	0.12	0.19	0.0500	0.0437	0.09	0.060
σ_σ	0.08	0.14	0.0353	0.0309	0.065	0.042

Locality	S. of Funen E. of Taasinge	Limfjord (Jutland) Struer	Limfjord Lemvig	Limfjord Nykøbing	Limfjord Hals	Limfjord Thisted Bredning
Date of capture	June 9. 1915	April 7. 1887	May 27. 1915	May 8. 1916	May 20. 1916	Jan. 30. 1918
Maturity	V—VI	V—VI	V—VI	V—VII	IV—V	IV—V
Spawning time	May—June	April—May	May—June	April—May	May—June	..
Size (average in brackets)	20—26 (23)	24—28 (26)	21—28 (24)	21—28 (24)	21—26 (26)	21—30
Investigator	A. C. JOHANSEN	HEINCKE	A. C. JOHANSEN	A. C. JOHANSEN	A. C. JOHANSEN	A. C. JOHANSEN
No. of vertebrae (Vert. S.)	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency
53	..	..	..	1	..	..
54	6	..	8	2	..	1
55	56	12	82	42	68	37
56	134	31	155	87	122	78
57	26	7	25	11	20	19
n	222	50	270	143	210	135
m	55.81	55.90	55.730	55.73	55.771	55.85
σ	0.67	0.61	0.666	0.65	0.607	0.65
σ_m	0.045	0.087	0.0405	0.054	0.042	0.056
σ_σ	0.032	0.061	0.0286	0.012	0.029	0.040

No. of keeled scales (K_2)	Frequency	Frequency	Frequency	Frequency	Frequency	Frequency
12	..	..	..	..	1	1
13	14	4	42	21	18	8
14	125	17	145	89	131	63
15	86	9	78	32	55	57
16	16	..	5	1	5	6
n	241	30	270	143	210	135
m	14.43	14.17	14.17	14.09	14.214	14.44
σ	0.70	0.65	0.701	0.63	0.647	0.71
σ_m	0.045	0.12	0.0427	0.052	0.045	0.061
σ_σ	0.032	0.084	0.0302	0.037	0.032	0.043

Table II. Survey of the Analyses of Herrings from Eyjafjord at North Iceland, and Kongshavn at the Faroes.
(Oversigt over de udførte Analyser af Siild fra Øfjord paa Island og fra Kongshavn paa Færøerne).

A. Herrings from the North of Iceland off Eyjafjord. (Sild fra Nordkysten af Island udfor Øfjord).

Locality	Iceland, Eyjafjord (Island, Øfjord)			Size of specimens examined			
				cm	Ind.	cm	Ind.
Date	September 1915			28	1	33	59
				29	2	34	71
				30	..	35	16
Maturity	VIII, III, IV			31	6	36	8
				32	59		192

No.	Length cm	Sex	Maturity	Vertebrae			Keeled scales K 2	Rays in both ventral fins	Number of winter-rings in the scales, approximately
				Precaudal	Caudal	Total			
1	34	+	III	24	35	59	16	17	c. 9
2	33		VIII	24	33	57	15	20	6
3	36		III	24	33	57	14	18	8
4	34		III	23	34	57	14	18	c. 7
5	33		III	24	33	57	14	18	c. 12
6	34		III	25	32	57	13	18	7
7	34		III	23	34	57	14	18	c. 13
8	34		VIII	24	33	57	14	19	10—15
9	33		III	24	32	56	14	18	c. 12
10	32		VIII	25	31	56	15	16	c. 7
11	34		III—IV	24	34	58	15	18	c. 10
12	33		VIII	24	33	57	14	18	c. 10
13	34		VIII	24	34	58	13	18	c. 10
14	32		III	24	34	58	13	18	c. 11
15	33		III	23	34	57	14	18	c. 10
16	34		III	24	33	57	13	18	c. 11
17	33		III—IV	25	32	57	13	18	c. 9
18	34		VIII	25	32	57	13	19	c. 7
19	33		III—IV	23	34	57	13	18	c. 9
20	32		VIII	27	30	57	13	18	9
21	34		III	24	33	57	14	18	c. 7
22	33		III	25	32	57	14	18	9—10
23	33		VIII	26	31	57	12	18	6
24	31		VIII	24	33	57	13	18	8—9
25	33		VIII	24	33	57	14	18	8
26	32		III	25	33	58	14	16	8
27	34		VIII	24	32	56	16	18	c. 9
28	36		III—IV	24	33	57	14	18	c. 9
29	34		VIII	24	33	57	13	16	c. 9
30	32		III	24	33	57	12	18	c. 11
31	34		VIII	24	33	57	14	18	?
32	32		III	25	32	57	14	18	c. 10—11
33	33		III	24	33	57	14	18	c. 10
34	32		VIII	25	32	57	13	18	9
35	34		III	25	32	57	14	17	c. 10
36	36		VIII	23	34	57	14	18	c. 10
37	34		III	23	35	58	13	18	9
38	32		VIII	25	32	57	15	18	c. 6
39	33		III	24	33	57	13	18	c. 11
40	34		VIII	24	33	57	14	18	?
41	32		III	25	34	59	13	18	c. 5
42	33		III	25	33	58	14	17	c. 11
43	34		III	26	32	58	14	18	9
44	33		VIII	24	32	56	13	17	c. 10
45	31		II—III	24	33	57	14	18	c. 4
46	34		VIII	22	34	56	14	17	8
47	34		IV	24	34	58	13	18	c. 9
48	34		VIII	26	32	58	13	18	c. 10
49	35		III	25	33	58	13	18	c. 10
50	33		VIII	24	33	57	15	18	10—11
51	33		IV	23	33	56	25	18	10—12
52	33		IV	24	33	57	14	18	10—11
53	32		III	25	34	59	13	18	9—10
54	33		VIII	23	34	57	15	18	c. 8
55	32		IV	23	33	56	14	18	c. 9
56	34		III	24	33	57	14	18	12

[illegible]

No.	Length cm	Sex	Maturity	Vertebrae			Keeled scales K 2	Rays in both ventral fins	Number of winter-rings in the scales, approximately
				Precandal	Caudal	Total			
125	34		m	24	34	58	14	18	..
126	34		m	23	35	58	14	18	..
127	34		m	24	33	57	14	18	..
128	34		m	25	32	57	14	18	..
129	34		m	25	32	57	14	18	..
130	34		m	25	32	57	14	18	..
131	34		m	26	32	58	14	18	..
132	34		m	24	33	57	14	18	..
133	35		m	24	33	57	14	18	..
134	35		m	24	33	57	14	18	..
135	35		m	25	32	57	14	18	..
136	36		m	24	33	57	14	18	..
137	32		m	24	33	57	15	18	..
138	34		m	25	33	58	15	18	..
139	34		m	25	33	58	15	18	..
140	34		m	26	32	58	15	18	..
141	34		m	24	33	57	15	18	..
142	34		m	25	32	57	14	19	..
143	33		m	23	34	57	14	20	..
144	33		m	23	34	57	14	20	..
145	33		m	25	32	57	13	17	..
146	33		m	24	32	56	13	17	..
147	34		m	26	32	58	13	17	..
148	34		m	24	34	58	13	17	..
149	33		m	24	34	58	14	17	..
150	34		m	26	32	58	14	17	..
151	33		m	25	33	58	15	17	..
152	29		m	24	33	57	13	18	..
153	31		m	23	34	57	13	18	..
154	32		m	24	33	57	13	18	..
155	34		m	25	33	58	13	18	..
156	34		m	24	34	58	13	18	..
157	34		m	24	35	59	13	18	..
158	34		m	26	33	59	13	18	..
159	34		m	24	32	56	13	18	..
160	33		m	24	33	57	13	18	..
161	35		m	25	32	57	13	18	..
162	36		m	24	34	58	13	18	..
163	32		m	24	32	56	14	18	..
164	32		m	24	32	56	14	18	..
165	33		m	25	34	59	14	18	..
166	33		m	26	32	58	14	18	..
167	33		m	25	32	57	14	18	..
168	33		m	24	33	57	14	18	..
169	33		m	24	34	58	14	18	..
170	33		m	24	33	57	14	18	..
171	33		m	24	33	57	14	18	..
172	33		m	24	34	58	14	18	..
173	34		m	25	32	57	14	18	..
174	34		m	24	34	58	14	18	..
175	34		m	26	32	58	14	18	..
176	34		m	25	33	58	14	18	..
177	34		m	23	34	57	14	18	..
178	34		m	23	34	57	14	18	..
179	34		m	24	33	57	14	18	..
180	35		m	23	34	57	14	18	..
181	35		m	25	32	57	14	18	..
182	36		m	25	33	58	14	18	..
183	31		m	24	34	58	15	18	..
184	34		m	25	33	58	15	18	..
185	34		m	25	32	57	15	18	..
186	34		m	24	34	58	15	18	..
187	35		m	24	33	57	15	18	..
188	35		m	25	34	59	15	18	..
189	35		m	25	32	57	15	18	..
190	35		m	25	33	58	15	18	..
191	35		m	25	33	58	16	18	..
192	31		m	25	33	58	15	20	..

B. Herrings from Kongshavn at the Faroes. (Sild fra Kongshavn paa Færøerne).

Locality	Kongshavn. The Faroes		Size of specimens examined					
			cm	Ind.	cm	Ind.	cm	Ind.
Date	Sept. 10. — 1915		19	1	24	52	29	1
Maturity	I—II (in a few cases IV—VIII)		20	1	25	39	30	6
			21	8	26	19	31	2
Remarks	Caught in the Skaalebotten, 19—23 metres		22	28	27	11	32	1
			23	44	28	3		216

No.	Length cm	Sex	Maturity	Vertebrae			Keeled scales K 2	Rays in both ventral fins	Number of winter-rings in the scales, approximately
				Precaudal	Caudal	Total			
1	22.4	O ₁	II	23	35	58	13	18	2
2	23.5		II	25	32	57	13	18	3 or 4
3	26.3		II	24	34	58	14	18	3
4	30.5		IV—V	25	32	57	15	16	7
5	20.5		I	24	33	57	12	18	1
6	25.2		II	26	31	57	14	18	3
7	29.0		m	26	31	57	13	18	c. 5
8	25.6		II	25	33	58	13	18	3
9	25.1		II	23	34	57	14	18	3
10	23.3		II	24	33	57	14	18	2
11	23.0		II	23	33	56	14	16	2
12	25.2		II	24	33	57	14	18	3
13	26.6		II	23	34	57	14	17	3
14	27.3		II	24	33	57	13	18	3
15	24.0		II	24	34	58	13	18	3
16	23.6		I	25	33	58	13	18	3
17	24.7		II	25	33	58	14	18	3
18	22.8		I	25	32	57	14	18	2 or 3
19	21.9		I	25	32	57	14	18	2
20	23.8		I	24	32	56	14	18	2 or 3
21	23.1		I	22	35	57	15	18	2
22	31.1		m	24	34	58	14	18	5 or 6
23	24.5		II	24	33	57	13	18	3
24	22.3		II	23	34	57	15	18	2
25	24.5		II	23	33	56	15	18	3
26	23.4		II	25	32	57	14	18	3
27	24.2		II	24	34	58	14	18	2
28	24.6		II	24	34	58	15	18	3
29	22.8		II	24	33	57	14	18	2
30	24.0		I	24	33	57	14	18	2
31	26.6		II	23	33	56	14	18	3
32	25.1		I	23	34	57	15	18	3
33	25.0		II	23	34	57	15	18	2
34	26.4		II	22	34	56	14	18	3
35	24.1		I	24	33	57	14	18	3
36	22.6		I	25	33	58	13	18	3
37	24.6		II	24	34	58	14	18	2
38	23.9		I	25	33	58	14	18	2
39	23.6		I	24	34	58	14	18	2
40	20.9		I	25	32	57	13	18	2
41	23.0		I	25	33	58	14	18	2
42	21.7		I	23	32	55	14	18	2
43	26.8		II	24	33	57	13	18	2 or 3
44	21.8		I	26	31	57	14	18	2
45	21.8		I	25	34	59	13	18	2
46	20.8		I	24	33	57	14	18	1
47	22.6		I	24	33	57	14	18	2
48	25.3		II	24	33	57	15	18	3
49	22.6		I	24	33	57	13	19	2
50	22.3		I	24	35	59	15	18	2
51	24.3		I	24	34	58	14	18	2
52	25.4		I	24	33	57	14	18	3
53	24.9		I	25	32	57	13	18	3
54	24.8		I	24	33	57	14	16	2
55	22.8		I	24	33	57	14	18	2
56	25.2		II	24	33	57	14	18	3
57	24.0		I	25	34	59	16	18	2

No.	Length cm	Sex	Maturity	Vertebrae			Keel scales K 2	Rays in both ventral fins	Number of winter-rings in the scales. approximately
				Precaudal	Caudal	Total			
58	26.0		I-II	26	31	57	13	19	3
59	21.4		I	23	35	58	14	18	2
60	23.2		I	24	34	58	14	18	2
61	30.1		IV-V	23	34	57	14	18	6-8
62	24.6		I	24	33	57	13	18	3
63	22.0		I	25	33	58	14	18	2
64	25.5		I	25	32	57	15	18	2
65	26.1		I-II	23	35	58	13	18	3
66	24.7		I	25	32	57	15	18	2
67	21.9		I	24	33	57	14	18	2
68	22.8		I	24	33	57	14	17	2
69	25.1		I	24	34	58	14	16	3
70	25.1		I-II	24	34	58	14	16	3
71	26.9		I-II	25	32	57	13	18	2 or 3
72	24.7		I	24	33	57	14	18	3
73	24.7		I	24	34	58	14	18	2
74	22.6		I	23	35	58	15	18	2
75	25.4		I-II	24	33	57	16	18	2
76	29.7		II-III	24	34	58	14	18	3
77	31.5		III	23	34	57	14	18	5 or 6
78	28.0		m	23	35	58	13	18	3
79	30.2		m	24	33	57	14	18	3
80	30.4		m	24	31	55	15	18	c. 8
81	29.5		II-III	24	34	58	14	18	3
82	30.3		m	24	33	57	13	18	4
83	26.4		I-II	25	33	58	13	18	3
84	25.5		I	24	33	57	13	18	3
85	23.7		I	24	34	58	14	18	2
86	24.0		I	24	33	57	13	18	2
87	22.4		I	25	32	57	14	18	2
88	26.4		II	23	35	58	14	18	3
89	26.3		II	25	32	57	13	18	4
90	26.1		II	25	33	58	14	18	3
91	27.8		II	24	33	57	14	18	3
92	27.8		II	24	33	57	15	18	4
93	25.0		II	24	34	58	14	18	3
94	26.4		II	24	34	58	13	18	3
95	26.5		II	24	33	57	14	18	3
96	25.2		I	25	32	57	14	18	3
97	26.6		I	25	32	57	14	18	3
98	23.9		I	24	33	57	13	18	2
99	27.2		II	24	34	58	14	18	3
100	22.8		I	25	32	57	14	18	2
101	24		i	24	32	56	12	18	..
102	23		i	23	33	56	13	16	..
103	24		i	24	32	56	13	16	..
104	25		i	25	32	57	13	16	..
105	23		i	24	34	58	13	17	..
106	23		i	24	33	57	13	17	..
107	23		i	24	32	56	13	17	..
108	24		i	25	32	57	13	17	..
109	24		i	24	34	58	13	17	..
110	24		i	24	34	58	13	17	..
111	19		i	24	33	57	13	18	..
112	21		i	24	33	57	13	18	..
113	21		i	25	33	58	13	18	..
114	22		i	24	33	57	13	18	..
115	22		i	25	33	58	13	18	..
116	22		i	24	34	58	13	18	..
117	22		i	25	33	58	13	18	..
118	23		i	25	33	58	13	18	..
119	23		i	24	33	57	13	18	..
120	23		i	25	33	58	13	18	..
121	23		i	25	33	58	13	18	..
122	23		i	24	33	57	13	18	..
123	23		i	24	34	58	13	18	..
124	23		i	24	33	57	13	18	..
125	24		i	25	33	58	13	18	..

No.	Length cm	Sex	Maturity	Vertebrae			Keel scales K 2	Rays in both ventral fins	Number of winter-rings in the scales, approximately
				Precaudal	Caudal	Total			
126	24	..	i	24	34	58	13	18	..
127	24	..	i	26	31	57	13	18	..
128	24	..	i	24	33	57	13	18	..
129	24	..	i	24	33	57	13	18	..
130	24	..	i	25	32	57	13	18	..
131	24	..	i	24	34	58	13	18	..
132	24	..	i	25	33	58	13	18	..
133	24	..	i	23	34	57	13	18	..
134	24	..	i	26	32	58	13	18	..
135	25	..	i	25	33	58	13	18	..
136	26	..	i	24	33	57	13	18	..
137	26	..	i	24	33	57	13	18	..
138	23	..	i	24	33	57	14	16	..
139	23	..	i	26	32	58	14	16	..
140	23	..	i	25	31	56	14	17	..
141	23	..	i	24	34	58	14	17	..
142	23	..	i	25	32	57	14	17	..
143	24	..	i	26	32	58	14	17	..
144	25	..	i	24	33	57	14	17	..
145	21	..	i	24	32	56	14	18	..
146	21	..	i	23	34	57	14	18	..
147	22	..	i	24	34	58	14	18	..
148	22	..	i	24	33	57	14	18	..
149	22	..	i	25	32	57	14	18	..
150	22	..	i	25	33	58	14	18	..
151	22	..	i	26	31	57	14	18	..
152	22	..	i	24	34	58	14	18	..
153	22	..	i	28	31	59	14	18	..
154	22	..	i	26	32	58	14	18	..
155	22	..	i	24	34	58	14	18	..
156	22	..	i	24	33	57	14	18	..
157	22	..	i	26	32	58	14	18	..
158	23	..	i	25	33	58	14	18	..
159	23	..	i	24	33	57	14	18	..
160	23	..	i	24	34	58	14	18	..
161	23	..	i	25	32	57	14	18	..
162	23	..	i	26	32	58	14	18	..
163	23	..	i	24	34	58	14	18	..
164	23	..	i	26	32	58	14	18	..
165	23	..	i	27	31	58	14	18	..
166	23	..	i	24	34	58	14	18	..
167	24	..	i	25	33	58	14	18	..
168	24	..	i	24	34	58	14	18	..
169	24	..	i	26	32	58	14	18	..
170	24	..	i	24	33	57	14	18	..
171	24	..	i	24	33	57	14	18	..
172	24	..	i	25	33	58	14	18	..
173	24	..	i	25	33	58	14	18	..
174	24	..	i	25	33	58	14	18	..
175	24	..	i	25	33	58	14	18	..
176	24	..	i	24	33	57	14	18	..
177	24	..	i	24	35	59	14	18	..
178	24	..	i	27	31	58	14	18	..
179	24	..	i	24	34	58	14	18	..
180	24	..	i	24	42	56	14	18	..
181	24	..	i	25	33	58	14	18	..
182	24	..	i	25	33	58	14	18	..
183	25	..	i	26	32	58	14	18	..
184	25	..	i	25	33	58	14	18	..
185	25	..	i	24	34	58	14	18	..
186	25	..	i	25	32	57	14	18	..
187	25	..	i	28	31	59	14	18	..
188	25	..	i	23	35	58	14	18	..
189	25	..	i	24	34	58	14	18	..
190	25	..	i	24	33	57	14	18	..
191	25	..	i	25	33	58	14	18	..
192	25	..	i	25	33	58	14	18	..
193	25	..	i	26	32	58	14	18	..

No.	Length cm	Sex	Maturity	Vertebrae			Keeled scales K 2	Rays in both ventral fins	Number of winter-rings in the scales, approximately
				Precaudal	Caudal	Total			
194	25	..	i	25	33	58	14	18	..
195	26	..	i	24	33	57	14	18	..
196	26	..	i	24	33	57	14	18	..
197	26	..	i	25	32	57	14	18	..
198	26	..	i	27	31	58	14	18	..
199	27	..	i	24	34	58	14	18	..
200	27	..	i	24	33	57	14	18	..
201	20	..	i	24	33	57	15	18	..
202	22	..	i	25	33	58	15	18	..
203	22	..	i	24	33	57	15	18	..
204	22	..	i	24	33	57	15	18	..
205	23	..	i	24	35	59	15	18	..
206	23	..	i	25	32	57	15	18	..
207	23	..	i	26	32	58	15	18	..
208	23	..	i	26	33	59	15	18	..
209	24	..	i	25	34	59	15	18	..
210	24	..	i	25	32	57	15	18	..
211	24	..	i	24	34	58	15	18	..
212	24	..	i	25	32	57	15	18	..
213	24	..	i	25	33	58	15	18	..
214	24	..	i	25	34	59	15	18	..
215	26	..	i	24	34	58	15	18	..
216	27	..	i	24	33	57	15	18	..

DANSK RESUME

Om den store foraarsgydende Havsild (*Clupea harengus* L.) i de nordvest-europæiske Farvande.

Under mine Studier over Sildens Racer og Vandringer i de nordeuropæiske Farvande er jeg blevet opmærksom paa, at den store islandske Foraarsild og den store norske Foraarsild ligner hinanden saa meget, at det er tvivlsomt, om man altid vil være i Stand til at skelne de to Grupper af Sild fra hinanden. Ligeledes har jeg fundet, at et Antal af unge Fedsild fra Færøerne, som jeg har undersøgt, ikke viser særlig udprægede Ejendommeligheder, men staar saa nær baade ved den norske Vaarsild og den islandske Vaarsild, at man ikke tør være sikker paa, at den er udviklet ved Færøerne. Jeg anser disse Iagttagelser for saa betydningsfulde, at jeg finder det rigtigst at henlede Opmærksomheden herpaa allerede nu, skønt der endnu kun foreligger faa Analyser af Sild fra Island og Færøerne.

Af den store norske Foraarsild er der allerede af HEINCKE og KNUT DAHL og navnlig af HJ. BROCH foretaget saa omfattende Analyser, at Kendetegnene for denne med Hensyn til de Karakterer, jeg har haft for Øje, er ret vel oplyste.

Ved den foreløbige Sortering af de Sild, der undersøges nærmere, har jeg benyttet følgende Karakterer:

1. Sildens Totallængde.

Denne maales fra Underkæbens forreste Parti langs Kroppens Midtlinie over Indbugtningen paa Halefinnen til den yderste Spids af Halefinnens dorsale Flig, efter at denne er bøjet ned udfor Midten af Kroppen¹ (Fig. 1 Side 3). HEINCKE maalte Sildens Totallængde fra Underkæbens forreste Parti langs Kroppens Midtlinie til en Linie, der forbinder Halefinnens Yderspidser, naar denne ligger i naturlig Stilling.² Men dels er det forbundet med en vis Besværlighed at anstille Maalinger paa denne Maade, dels er det ikke let paa døde — og maaske præparerede — Eksemplarer at afgøre, hvornaar Halefinnen indtager den naturlige Stilling. Ved de to Maalemetoder faas dog meget nær det samme Resultat. Selv hos store Individuer drejer det sig ikke om en Afvigelse af mere end ca. 1 mm. Undertiden er den fundne Længde afrundet ned til den nærmeste hele Centimeter. Undertiden er Længden angivet i Millimeter.

2. Sildens Køn.

3. Sildens Modenhedstilstand.

Modenhedstilstanden er bestemt paa lignende Maade som hos HEINCKE², men Bestemmelserne er nøjere præciserede.

Modenhed I betegner Sild, der aldrig har gydet, og hvis Køn kun kan bestemmes ved Mikroskopets Hjælp. Højden af Ovarium og Testes under 3 mm.

¹ Denne Metode anvendes af The Board of Agriculture and Fisheries in England. Se W. RIDDEL: Report on Herring Measurements. Lancashire Sea-Fisheries Laboratory Rep. No. XXIII for 1914.

² FR. HEINCKE: Naturgeschichte des Herings. Abhandlungen d. deutschen Seefischerei-Vereins. Bd. II. Heft. I u. II. 1898.

- Modenhed II. Sild med smaa Kønsganaler. Æggene kan adskilles ved Hjælp af en Loupe. I de fleste Tilfælde drejer det sig her om Sild, der ikke har naaet Kønsmodenheden. Ovariet har i Reglen en rød Farve, Testes en rødgraa Farve. Højden af Ovarier og Testes ca. 3—8 mm.
- III. Æggene kan skelnes med blotte Øje. Deres Diameter er 0.2—0.5 mm. Testes rødgraa eller graalig. Kønsganalerne Højde i Reglen ca. 8—15 mm.
- IV. Æggene ret store, ca. 0.5—0.8 mm i Diameter. Testes hvidlig. Kønsganalerne Højde i Reglen over 15 mm.
- V. Hele Bughulen opfyldt af Kønsganalerne. Æggene omkring 0.8—1 mm i Diameter. Testes ren mælkehvid.
- VI. Rogn og Mælke flydende.
- VII. Udgydt. Ovarierne tomme eller kun med enkelte Reliktæg. Testes sækformige og ligesom Ovarierne blodsprængte (Blodsild).
- VIII. Voksne Individer, der for en Tid siden har overstaaet Gydningen. Æggene som i Stadium I—II, men Ovarier og Testes af større Dimensioner. Dette Stadium glider over i Stadium III.

Et Stadium omtrent svarende til mit Stadium VIII betegnes af HEINCKE som IIa. Hos yngre Individer kan Ovarier og Testes efter Gydningen blive reduceret til samme eller omtrent samme ringe Størrelse som ved Begyndelsen af det umodne Stadium II, men hos ældre Individer vil man ikke finde Ovarier og Testes saa smaa i noget Stadium efter Gydningen som de var ved Begyndelsen af det umodne Stadium II, selv om Æggene er af samme ringe Størrelse som i dette Stadium.

Den af HEINCKE benyttede Betegnelse for den forskellige Modenhedstilstand er med visse Modifikationer anvendt af en Række andre Forskere, som BROCH¹, HJORT & LEA², W. RIDDEL³, J. H. ORTON⁴ o. a.

Hos en Del af de undersøgte Individer er Antallet af »Vinterringe« i Skællene talte. (Fig. 2, Side 5).

Ved den nøjere Analyse af Silden, der skal tjene til at karakterisere de forskellige Racer, har jeg kun anvendt Karakterer, der engang anlagte og fæstnede forbliver konstante under Individets hele Levetid. Hermed skal ikke være sagt, at de relative Maal, som Forholdet mellem forskellige Dimensioner paa Fisken, ikke er egnede til at bruges ved Raceanalyserne. Men forinden man tør drage Slutninger med Hensyn til Raceforskelligheder fra saadanne relative Maal, bør der være tilvejebragt Klarhed over, i hvilken Grad disse Proportioner varierer under Individernes Udvikling og skiftende Kaar. De meget omfattende Undersøgelser, der fordres for at tilvejebringe de nødvendige Oplysninger af denne Art, er endnu ikke udførte. En uensartet Behandling af Fisken før Maalingerne, f. Eks. med Hensyn til Konserveringen kan influere paa mange af de relative Maal.

De af mig anvendte individuelt konstante Karakterer er følgende:⁵

1. Totalantallet af Hvirvler.
2. Antallet af præcaudale Hvirvler.
3. Antallet af Kølskæl mellem Bugfinnerne og Anus (K 2).
4. Antallet af Bugfinnestraaler i begge Bugfinner.

Hver enkelt af disse Karakterer fortjener her en nærmere Omtale.

¹ HJALMAR BROCH: Norwegische Heringsuntersuchungen während der Jahre 1904—1906. Bergens Museums Aarbog 1908

² JOHAN HJORT: Report on Herring-investigations until January 1910. Publications de Circonstance. No. 53. Conseil. perm. internat. 1910.

³ W. RIDDEL: Herring investigations, Lancashire Sea-Fisheries Laboratory Report for 1913. No. XXII. Liverpool 1914. W. RIDDEL: Report on Herring measurements ibid. for 1914. No. XXIII. Liverpool 1915.

⁴ J. H. ORTON: An Account of the Researches on Races of Herrings, carried out by the Marine Biological Association at Plymouth, 1914—15. — Journal Marine Biol. Assoc., Plymouth, N. S. Vol. XI No. 1. March 1916.

⁵ Hos Silden fra visse andre Omraader har jeg anvendt flere andre individuelt konstante Karakterer ved Raceundersøgelsen, nemlig Antallet af Straaler i Rygfinnen, Gafinfinnen og den ene Brystfinne.

1. Totalantallet af Hvirvler (»Vert. S.«).

Antallet af Hvirvler er en Karakter, der let erkendes, og som vanskelig kan mistydes. Det er nødvendigt at præcisere, hvilken Hvirvel man anser for den sidste eller bageste, da alle Forskere her ikke er enige.¹ Som HEINCKE regner vi den Hvirvel for den bageste, der i Fig. 3—6 (Side 6—7) er betegnet med Tallet 1. Denne Hvirvel fortsætter sig bagtil og opadtil i Urostylen, der delvis er dannet af sammensmeltede rudimentære Hvirvler.

Hvirvlerne anlægges i Larvestadiet. Allerede naar Individerne har en Længde af ca. 40 mm, kan Tællingen foregaa med Nøjagtighed, idet man kan kende den »sidste« Hvirvel ved et Par ejendommelige bagud rettede Processer, der udgaar fra dens nedre Parti (Fig. 3, Side 6). Disse karakteristiske Processer findes gennem de senere Udviklingstrin hos unge og voksne Individider (Fig. 3—7, Side 6—7).

De rudimentære Hvirvler i Urostylen ses tydeligst hos de unge Individider fra Slutningen af Larvestadiet gennem Overgangsstadierne til de yngre fuldt forvandlede Stadier (r, r i Fig. 3—4, Side 6). Endnu hos de voksne Individider kan man i Reglen se en Antydning af en af disse Hvirvler (r i Fig. 5—6, Side 7).

Udenfor Urostylen er det ikke hyppigt, at der forekommer Sammenvoksninger eller Sammensmeltninger af flere Hvirvler. Naar dette er hændet, er de paagældende Individider blevne kasserede som ubrugbare for Undersøgelsen.

2. Antallet af præcaudale Hvirvler (»Præc. Vert.«),

der her bestemmes som: Antallet af Hvirvler foran den Hvirvel, der bærer den første lukkede Hæmalbue.

Denne Karakter erkendes let, men Skeletteringen maa foretages med Omhu, da det ellers kan ske, at Tværstykkerne paa de forreste Hvirvelbuer rives bort, saaledes at Numeret af den Hvirvel, der bærer den første Hæmalbue, ikke med Sikkerhed kan fastslaaes. Dertil kommer, at det synes at være ret tilfældigt, om Hæmalbuen bliver fuldstændig lukket eller ikke. Inkomplette, ikke helt lukkede Hæmalbuer, optræder ofte (Fig. 8, Side 8), og ikke sjældent hænder det, at der bagved en helt lukket Hæmalbue forekommer én eller flere inkomplette Buer.

Denne Karakter er mere variabel end den foregaaende, og jeg anser det for sandsynligt, at den paavirkes i højere Grad af ydre Faktorer end Totalantallet af Hvirvler.

Den af os benyttede Karakter: De præcaudale Hvirvler er lig med den af HEINCKE benyttede Karakter: »Vert. H.« minus 1, idet HEINCKE har regnet med Numeret paa den Hvirvel, der bærer den første lukkede Hæmalbue.

3. Antallet af Kølskæl mellem Bugfinnerne og Gattet (K 2).

Det er her af Vigtighed at slaa fast, hvilket Kølskæl man betragter som det forreste. Dette er vist paa Fig. 9 (Side 8). Skællet *a* er (som hos HEINCKE) her betragtet som det forreste. Det er placeret udfor den forreste Del af Bugfinnernes Basalparti.

Det bageste Kølskæl er undertiden rudimentært, saaledes at der maa vises stor Forsigtighed med Tællingen. Selv det mest rudimentære Skæl er talt med.

Kølskællene anlægges senere end Hvirvlerne. De fremkommer først, naar Forvandlingen er afsluttet, og Individerne har en Længde af ca. 50 mm.

4. Antallet af Bugfinnestraaler.

Antallet af Bugfinnestraaler erkendes i Almindelighed let. Er den ene eller begge Bugfinner tydeligvis abnorme paa Grund af Beskadigelse eller af andre Aarsager, er Individet ikke medtaget ved Undersøgelsen. Det angivne Antal Straaler er Totalantallet i begge Finner tilsammen.

(Om Beregningsformlerne etc. se Side 8).

¹ J. H. ORTON regner den af os i Fig. 3—5 (Side 6 og 7) med Tallet 2 betegnede Hvirvel for den bageste (l. c. 1916 p. 80).

Den islandske Sild.

Størstedelen af de islandske Sild, jeg har haft til Undersøgelse, stammer fra Omraadet omkring Øfjord paa Nordlandet. Ved Imødekommenhed fra Dr. JOHS. SCHMIDT og efter Opfordring fra den kendte islandske Naturforsker BJ. SÆMUNDSSON i Reykjavik har Købmand JACOB BJÖRNSSON i Svalbardseyri sendt mig en Prøve af Sild af den sædvanlige Handelsvare fra Nordlandet, fanget i September 1915. Af Prøven undersøgte 192 Individer, hvis Størrelse var følgende:

cm	♂	♀	?(steril)	Ialt
28	1	..	..	1
29	1	1	..	2
30	..	..	..	..
31	2	4	..	6
32	10	19	..	29
33	26	33	..	59
34	22	49	..	71
35	3	13	..	16
36	2	5	1	8
	67	124	1	192
Gennemsnitslængde: 33·2 cm		33·5 cm	33·4 cm (+ 0·5 cm)	

De paagældende Individer havde enten gydet tidligere eller vilde opnaa Modenheden i den nærmest forestaaende Gydeperiode.

Antallet af Hvirvler, Kølskæl og Bugfinnestraaler hos de undersøgte Individer var følgende:

Hvirvler (Vert. S.)		Præcaudale Hvirvler		Kølskæl (K 2)		Bugfinnestraaler	
Antal	Hyppighed	Antal	Hyppighed	Antal	Hyppighed	Antal	Hyppighed
56	14	22	1	12	5	16	5
57	106	23	20	13	53	17	17
58	60	24	90	14	104	18	161
59	12	25	64	15	28	19	5
..	..	26	15	16	2	20	4
..	..	27	2	..	..	..	..
n	192		192		192		192
m	57·36		24·41		13·84		17·93
σ	0·71		0·84		0·74		0·55
σ _m	0·051		0·061		0·053		0·040
σ _σ	0·036		0·043		0·038		0·028

For de undersøgte Karakterer er Middelaftvigelsen (σ) her af samme Størrelse, som man plejer at finde den ved Analyser af gydefærdige Sild fra en og samme Stime. Størrelsen af σ peger da ikke hen paa, at man har med Blandinger af forskellige Racer at gøre, men Muligheden for, at Prøverne kan være en Blanding, f. Eks. af to hinanden nærstaaende Racer, er ikke udelukket.

Naar og hvor gyder den store Havsild, der fanges ved Islands Nordkyst
i Sommertiden?

Ved Nordisland fra Kap Nord paa Nordvestlandet forbi Kap Langenæs paa Nordøstlandet foregaar der i Sommertiden fra Juli til Midten af September et overordentlig vigtigt Fiskeri efter Silden med Snurpenot og Drivgarn, særlig fra norsk og islandsk Side. Den Sild, der her overvejende fanges, er en stor, ret fed Havsild af ca. 30—40 cm Længde med Middellængde ca. 35 cm.

Da der hverken fra Nordlandet eller Østlandet kendes fuldmodne, gydende Sild, og da Dr. JOHS. SCHMIDT ved sine Undersøgelser ved Islands Kyster i Aarene 1903—05 iagttog, at den spæde Sildeyngel manglede paa Nord- og Østlandet i Foraarstiden og Forsommeren, men forekom ved Syd- og Vestlandet,¹

¹ JOHS. SCHMIDT: Fiskeriundersøgelser ved Island og Færøerne i Sommeren 1903. Skrifter udg. af Kommissionen for Havundersøgelser No. 1. København 1904.

antog baade han og SÆMUNDSSON¹, at Silden ikke yngler ved Nord- og Østkysten, men ved Syd- og Vestkysten, og at den efter Yngletiden trækker om paa Nord- og Østlandet.

Den norske Naturforsker LEA har undersøgt Modenhedsgraden, Fedtindholdet, Alderen etc. af 419 Sild, fanget i Snurpenot 3 km N. for Siglunæs ved Indgangen til Øfjord d. 25. Juli 1908.² De paagældende Individer havde en Længde af 31—39 cm, i Gennemsnit ca. 35.5 cm. For 414 af disse Individer betegner LEA Modenhedstilstanden som II, for to Hunner paa 35 og 36 cm og en Han paa 37 cm angives Modenhedstilstanden III, og for en Hun paa 37 cm angives Modenhedstilstanden IV. For den store Hovedmasse af disse Sild angives Mængden af Fedt i Krophulen ved 2 (middel fed) og for adskillige ved 3 (meget fed), og for enkelte ved 1 (ikke videre fed). Denne ret betydelige Fedme viser hen til, at det ikke drejer sig om Individer, der netop har overstaaet Gydningsen. Paa den anden Side var alle de undersøgte Individer med Undtagelse af en enkelt Hun ret langt fra Gydetiden. Deres betydelige Størrelse og Alder gør det uomtvisteligt, at det i det store og hele drejer sig om voksne Fisk, der tidligere har gydet én eller flere Gange.

LEA har endvidere undersøgt 210 voksne Havsild af 31—38 cm Længde, fangede ved Nord-Island i September 1909. Modenhedstilstanden hos de fleste Individer var nu II, II—III, III eller III—IV. Elleve Hanner viste Modenheden IV og tre Hanner Modenheden IV—V. De fleste Individer betegnes som middelfede.

De undersøgte Individer var saaledes gennemgaaende en Del nærmere ved det fuldmodne Stadium end Individerne fra Juli, men ingen af Hunnerne var dog nær ved Gydestadiet. For Hannernes Vedkommende viser det sig ofte i Efteraarstiden, at Kønorganerne kan være stærkt udviklede (Modenhed III, IV eller IV—V), et halvt Aars Tid førend Gydningsen finder Sted.

De fleste af mig undersøgte Individer fra Nordlandet fra September havde Modenheden VIII, II—III, III, III—IV eller IV (Tabel II, Side 36—37). I nogle Tilfælde kunde jeg paa det saltede Materiale, der stod til min Raadighed for Hannernes Vedkommende ikke afgøre, om det drejede sig om Individer ved Slutningen af Gydestadiet (VI) eller om Individer af Modenhed III—IV.

Alt i alt peger de af LEA og mig foretagne Analyser hen paa, at Hovedmassen af den store Havsild ved Islands Nordkyst gyder i Foraarsiden. Om Gydestedet giver vore Undersøgelser ingen Oplysninger.

Den færøiske Sild.

Ved velvillig Imødekommenhed fra Dr. JOHNS. SCHMIDT's Side har jeg modtaget en Prøve af saltede Sild fra Færøerne til Undersøgelse.

Silden fangedes i Skaalebotten inderst i Kongshavn ved 19—23 m d. 10de September 1915. Af Prøven undersøgtes 207 Fedsild af Modenhed I—II og af Længde fra 20—27 cm (se Tabel II B., Side 39).

Antallet af Hvirvler, Kølskæl (K 2) og Bugfinnestraaler var følgende:

Hvirvler (Vert. S.)		Præcaudale Hvirvler		Kølskæl (K 2)		Bugfinnestraaler	
Antal	Hyppighed	Antal	Hyppighed	Antal	Hyppighed	Antal	Hyppighed
55	1	22	2	12	2	16	9
56	12	23	18	13	59	17	13
57	93	24	102	14	116	18	183
58	91	25	63	15	28	19	2
59	10	26	17	16	2	..	..
..	..	27	3	..	..	..	..
..	..	28	2	..	..	..	..
<i>n</i>	207		207		207		207
<i>m</i>	57.47		24.44		13.85		17.86
σ	0.70		0.92		0.69		0.48
σ_m	0.049		0.064		0.048		0.033
σ_σ	0.035		0.045		0.034		0.023

¹ BJARNI SÆMUNDSSON: Oversigt over Islands Fiske. Skrifter udg. af Kommissionen for Havundersøgelser No. 5. København 1908.

² JOHAN HJORT: Report on Herring-investigations until January 1910. Publications de circonstance. No. 33. Conseil perm. internat. 1910.

Det vil ses, at vi her for alle fire Karakterer praktisk talt har de samme Middeltal som for den islandske Silde Vedkommende. Sammenstilles de fundne Tal for Prøverne fra Øfjord og Kongshavn, faas følgende Resultat:

Diff. Vert. S.	Kongshavn minus Øfjord	+ 0 11	Middelfejl paa	Diff. 0·071
— Prec. Vert.	—	—	+ 0·03	—
— K 2	—	—	+ 0·01	—
— Bugf. Str.	—	—	÷ 0·071	—

Middelfvigelsen (σ) for de undersøgte Karakterer har for Prøven fra Kongshavn omtrent samme Størrelse som for Silden fra Islands Nordkyst.

Gydetiden for de undersøgte Fedsild er ubekendt, ligesom det heller ikke vides, om de er udviklede ved Færøerne. Da de ligner baade den islandske Foraarsild og den norske Foraarsild grumme meget, men afviger stærkt fra den shetlandske og den skotske sommer- og efteraarsgydende Sild, bl. a. i Henseende til Antallet af Kølskæl, er Sandsynligheden størst for, at det er Foraarsild. Centralfeltet i Skællene er i Reglen lille.

I Følge velvillig Oplysning fra Dr. JOHS. SCHMIDT findes der ved Færøerne en Sild, der gyder i Foraarsiden. Dette fremgaar f. Eks. af, at der i Trangisvaag Fjord fra Motorskonnerten »Margrethe« i Begyndelsen af Juni 1913 er indfanget anseelige Mængder af spæd Sildeyngel af 10—11 mm Gennemsnitslængde og ned til ca. 8 mm Længde.

Den store norske Foraarsild.

Blandt norske Fiskere og Handelsmænd inddeles den store norske Foraarsild gerne i fire forskellige Hovedgrupper: Smaasild, Fedsild, Storsild og fuldmodne Sild (kaldet Vaarsild). Ganske bortset fra Spørgsmaalet om, hvorvidt den store norske Foraarsild hører til samme Race eller til to (eller flere) forskellige Racer, er det uden for enhver Tvivl, at der inden for en og samme Race findes Sild, der hører til enhver af disse fire Grupper. Disse Kategorier adskilles fra hinanden ved forskellig Størrelse, forskellig Modenhedstilstand etc.

Smaasild er unge Individuer af Modenhedstilstand I. Deres Størrelse er i Følge HJORT under 19 cm, og deres Fedtindhold ikke særlig betydeligt.

Fedsilden er den noget ældre Ungsild. Dens Modenhedsgrad er I, I—II eller II. (Se Side 43—44). Hos denne Sild findes betydelige Mængder af Flommefedt (Ister) ved Tarmene. Denne Sild er federe end nogen af de andre Kategorier. Dens Længde ligger i Følge HJORT som Regel mellem 19 og 26 cm.

Storsilden er Betegnelsen dels for den Sild, der nærmer sig Kønsmodenheden for første Gang, dels — og navnlig — for den Sild, der har gydet, og som ikke er nær ved at skulle gyde igen (Modenhed II—III, III, III—IV, IV og VIII). Af denne Sild udskilles ofte Blodsilden, der nylig har overstaaet Gydningen, som en særlig Kategori (Modenhed VII).

Den fuldmodne Sild har Modenhedsgraden V eller VI. Gydningen foregaar hovedsagelig i Marts Maaned.

Af den store norske Foraarsild har HEINCKE analyseret et mindre Antal (anf. Sted 1898) og HJ. BROCH et større Antal.¹ Sammendrages de Analyser, disse Forfattere har udført af Storsild og Fuldsild af Modenhedsgraden IV—VI fra Norges sydvestlige Kyster mellem Haugesund (ved 59°23' N. Br.) og Aalesund (ved ca. 62°30' N. Br.), faas følgende Resultat:

¹ HJALMAR BROCH: Norwegische Heringsuntersuchungen während der Jahre 1904—1906. Bergens Museums Aarbog 1908. No. 1.

Hvirvler (Vert. S.)		Præcaudale Hvirvler		Kølskæl (K 2)		Bugfinnestraaler	
Antal	Hyppighed	Antal	Hyppighed	Antal	Hyppighed	Antal	Hyppighed
56	28	23	10	11	1	15	1
57	185	24	36	12	3	16	3
58	212	25	37	13	49	17	10
59	34	26	14	14	173	18	135
60	2	27	3	15	80	..	..
..	..	..	..	16	3	..	..
<i>n</i>	461		100		309		149
<i>m</i>	57.56		24.64		14.06		17.87
σ	0.74		0.95		0.72		0.44
σ_m	0.034		0.095		0.041		0.036
σ_σ	0.026		0.067		0.029		0.025

Fra Nordlands-Området (Sklinna Banke og Træna Banke etc.) mellem 65° og 67° N. Br. har HJ. BROCH i 1905 udført Analyser af et Antal Storsild og Fedsild af ensartet Præg. Trækkes disse Analyser sammen, faas følgende Resultat:

Hvirvler (Vert. S.)		Præcaudale Hvirvler		Kølskæl (K 2)		Bugfinnestraaler	
Antal	Hyppighed	Antal	Hyppighed	Antal	Hyppighed	Antal	Hyppighed
56	11	22	1	12	2	15	1
57	94	23	17	13	49	16	..
58	63	24	62	14	91	17	6
59	5	25	74	15	26	18	62
..	..	26	16	16	4	19	1
..	..	27	3	17	1	20	1
<i>n</i>	173		173		173		71
<i>m</i>	57.36		24.55		13.91		17.92
σ	0.65		0.88		0.79		0.53
σ_m	0.049		0.067		0.060		0.063
σ_σ	0.035		0.038		0.042		0.044

Sammenholder man de undersøgte Prøver af Foraarsild fra Sydnorge med Nordlandssilden, faas følgende Resultat:

Diff. Vert. S.	Vaarsild Sydnorge minus Nordlandssild				+ 0.20 m. Diff.	0.060
— Præc. Vert.	—	—	—	—	+ 0.09	— 0.12
— Kølskæl	—	—	—	—	+ 0.15	— 0.073
— Bugfinnestr.	—	—	—	—	÷ 0.05	— 0.102

I Antallet af Hvirvler er der her en Differens af over 3 Gange Middelfejlen og i Antallet af Kølskæl en Differens af over 2 Gange Middelfejlen. I et følgende Afsnit skal de mulige Aarsager til denne Differens diskuteres.

Foraarsgydende Sild i det nordlige Nordsøplateau.

HJ. BROCH har foretaget en Række Analyser af Sild fangede i Efteraaret 1904 fra "Michael Sars" og "Kinn" og i Efteraaret 1905 fra "Fritjof" i den nordligste Del af Nordsøen og de tilgrænsende Dele af Nordhavet mellem 60 og 62° N. Br. og 0—3° Ø. Længde. Ved sine Undersøgelser er BROCH kommen til det Resultat, at Silden i dette Omraade dels tilhører den sommer- og høstgydende Shetlandssild, dels den norske Foraarsild (l. c. 1908).

BROCH har adskilt Silden i to Grupper efter Modenhedstilstanden. Til den ene Gruppe regnes Stadierne II—III og III (samt enkelte i Stadierne I og II), og disse Sild var fede eller dog middelfede. Til den anden Gruppe regnes Stadiet VI, der svarer til mine Stadier VII og VIII (se Side 44). For dette Stadium angives sædvanlig "ingen Fedt" eller "Fedt kun i ringe Mængder" i Krophulen. Størrelsen

af Individierne i Stadiet I varierede fra ca. 23—26 cm (Fedsild) i Stadierne II—III og III fra 24—32 cm og i Stadiet VI fra ca. 26—32 cm.

BROCH har foretaget sine Analyser i Tiden fra 5te September til 2den November 1904, og fra 12. August til 26. Oktober 1905, og han slutter nu, at Individierne af Modenhedsstadierne II—III og III er foraarsgydende, medens Individierne af Modenhedsstadiet VI er høstgydende, og dette er sikkert ogsaa rigtigt.¹

Resultatet af Analyserne viser, at Silden ved den nævnte Sortering er bleven adskilt i to forskellige Racer, ialt Fald i Hovedsagen. Den ene Gruppe af Sild har et kendeligt højere Hvirveltal og et kendeligt lavere Antal Kølskæl end den anden. Resultatet af Analyserne er anført paa Side 21—23.

Den efteraarsgydende Sild fra det nævnte Omraade anser BROCH som omtalt for Shetlandssilden, medens han holder den foraarsgydende Sild for identisk med den store norske Foraarsild.

Vi vil betragte dette sidste Resultat lidt nøjere.

For 238 Foraarsild fra Nordsøplateauet er Middeltallet for Hvirvlerne (Vert. S.) 57·22. Efter de paa Side 22 anførte Specialanalyser kan Middelfejlen paa Middeltallet anslaaes til 0·04 à 0·05. Som anført Side 16 har de foretagne Analyser af 461 fuldmodne sydnorske Vaarsild vist, at Middeltallet af Hvirvler er 57·56 med en Middelfejl af 0·034. Sammenholder man disse to Middeltal faas en Differens af 0·34, med en Middelfejl paa Differensen af ca. 0·05. Her findes altsaa en virkelig Forskel i Antallet af Hvirvler.

Selv om man kun lægger de 128 Vaarsild fra Nordsøplateauet, hvoraf Specialanalyser foreligger (Side 23), til Grund for Sammenligningen med den sydnorske Foraarsild, viser der sig dog en virkelig Forskel i Antallet af Hvirvler, hvad der fremgaar af nedenstaaende Oversigt.

Diff. Vert. S.	Vaarsild Sydnorge minus Vikingbank	+ 0·32 Middelfejl paa	Differensen	0·072
— Præc. Vert.	— — — —	+ 0·27	—	— 0·122
— K 2	— — — —	÷ 0·03	—	— 0·077
— Bugfinnestr.	— — — —	÷ 0·04	—	— 0·061

En afgørende Forskel mellem Foraarssilden fra Nordsøplateauet og Silden fra Nordlandsdistriktet kan vel ikke paavises paa Grundlag af det forhaandenværende Materiale (se nedenstaaende Oversigt), men dette skyldes efter al Sandsynlighed kun den Omstændighed, at det undersøgte Materiale endnu er for lille. En Betragtning af alle Middeltallene for Hvirvler og Kølskællene af Silden fra de to Omraader, lader kun ringe Tvivl tilbage om, at Forskellen i Antallet vil vise sig at være betydningsfuld. (Se Side 21 og Side 20).

Diff. Vert. S.	Nordland Sild minus Vikingbank etc.	+ 0·12 Middelfejl paa	Differensen	0·080
— Præc. Vert.	— — — —	+ 0·18	—	— 0·101
— K 2	— — — —	÷ 0·18	—	— 0·088
— Bugfinnestr.	— — — —	+ 0·01	—	— 0·080

Sammenligner man Foraarssilden fra Nordsøplateauet med alle de undersøgte norske Foraarsild fra Skagerak, det sydvestlige Norge og Nordlandsdistriktet under ét, viser der sig en virkelig Forskel i Antallet af Hvirvler, hvad der fremgaar af nedenstaaende Oversigt.

Diff. Vert. S.	Norske Foraarsild minus Vikingbank	+ 0·26 Middelfejl paa	Differensen	0·069
— Præc. Vert.	— — — —	+ 0·23	—	— 0·092
— K 2	— — — —	÷ 0·07	—	— 0·073
— Bugfinnestr.	— — — —	÷ 0·02	—	— 0·056

Differensen paa Vert. S. er her ca. 4 Gange saa stor som Middelfejlen paa Differensen.

Hertil kommer, at nogle Aldersanalyser, som LEA har udført paa foraarsgydende Sild, der fangedes i Nordsøplateauet i September og Oktober 1909, viser, at disse Sild i 10—15 Aars Alderen har en betydelig ringere Gennemsnitsstørrelse end den norske Vaarsild i samme Alder. Størrelsesforskellen andrager her ca. 4 cm. Dette vil fremgaa af Oversigten paa Side 24 sammenlignet med Oversigten Side 28.

¹ For Individierne i Modenhedsstadiet I og II er Gydetiden ubekendt.

BROCH's Opfattelse, at de af ham undersøgte Vaarsild fra Nordsøplateauet i sin Helhed er norske Vaarsild, er da sikkert forkert, men den Mulighed er ikke udelukket, at Prøverne har indeholdt Bestanddele af denne Sild. Herom kan for Tiden intet vides.

Som det vil ses af nedenstaaende Oversigt, afviger Foraarssilden fra Nordsøplateauet kendeligt fra de undersøgte Sild fra Island og Færøerne ved et højere Antal Kølskæl. Differensen er her tre Gange saa stor som Middelfejlen paa Differensen.

Diff. Vert. S.	N. Island minus Vikingbank	+ 0.12	Middelfejl paa	Differensen	0.081
— Præc. Vert.	— — —	+ 0.04	—	—	0.097
— K 2	— — —	+ 0.25	—	—	0.084
— Bugfinnestr.	— — —	+ 0.02	—	—	0.063

Diff. Vert. S.	Kongshavn Færøerne minus Vikingbank	+ 0.23	Middelfejl paa	Differensen	0.080
— Præc. Vert.	— — —	+ 0.07	—	—	0.099
— K 2	— — —	+ 0.24	—	—	0.081
— Bugfinnestr.	— — —	+ 0.05	—	—	0.059

Der er da ikke Tvivl om, at ialt Fald en væsentlig Del af de af BROCH undersøgte Foraarsild fra Nordsøplateauet hører til en anden Race end de Sild, vi hidtil har beskæftiget os med. Hvor denne anden Race har sine Gydepladser, er ikke oplyst. De foreliggende faa Analyser af den skotske Vaarsild peger hen paa, at denne ikke har saa højt et Hvirveltal som Foraarssilden fra Nordsøplateauet (se Tabel I, Side 34), og den synes ogsaa gennemsnitlig at være af ringere Størrelse. Den Mulighed ligger da nær, at den undersøgte Foraarsild fra Nordsøplateauet som Helhed eller for en væsentlig Del er Udløbere for den foraarsgydende Shetlandssild, men først en nøjere Analyse af denne sidste vil kunne bringe Oplysninger om dette Forhold.

I Følge en Del Aldersbestemmelser, som LEA har udført paa shetlandske Foraarsild, fangede i 1909, er denne Sild mindre end den norske Vaarsild. LEA's Aldersanalyser har givet følgende Resultat (HJORT l. c. 1910 S. 141).

179 Sild, fangede i Drivgarn 12 Sømil fra Baltasund 13—2—1909.

Aargang	1906	1905	1904	1903	1902	1901	1900	1899
Antal Individer	5	7	18	83	38	13	7	8
— — i %	2.8	3.9	10.0	46.4	21.2	7.3	3.9	4.5
Gennemsnitslængde cm. . .	26.4	26.7	28.9	30.0	30.2	30.4	32.0	31.6

Disse Analyser viser hen til, at den shetlandske Foraarsild er en ret stor Sild, men at den dog er noget mindre end den norske Foraarsild. Størrelsen af de ældre Individer er omtrent som i de af LEA undersøgte Prøver af Sild fra Nordsøplateauet (se Side 24).

Det vil ses, at Aargangen 1904 ikke her, som i de fleste samtidige Prøver af norske Vaarsild, spiller nogen særlig fremtrædende Rolle.¹

LEA's Undersøgelser omfattede 179 Individer af Længde fra 26—33 cm, og praktisk talt alle var voksne Fisk, af Modenhed IV eller V, i Reglen V. Kun et enkelt Individ havde overstaaet Gydningen. I Følge DUTHIE² forekommer der ved Shetlandsøerne talrige Blodsild i Maj Maaned. Hovedgydetiden synes da at maatte være Marts—April.

Den shetlandske Foraarsild er vel ikke uden Vigtighed for de store shetlandske Sildefiskerier, men den betyder dog utvivlsomt langt mindre end den høstgydende Shetlandssild. Sildefiskeriet i Nærheden af Shetlandsøerne har sit Maksimum i Maanederne Juni til September, eller netop indenfor den Periode, da Gydningen af Høstsilden finder Sted.

¹ I denne Henseende lignede de af LEA undersøgte Sild fra Nordsøplateauet (September—Oktober 1909) de samtidige Prøver af norske Vaarsild.

² ROBERT DUTHIE: The Fisheries of Shetland. X. Ann. Report Fishery Board for Scotland for 1891. Edinburgh 1892.

Det er en nærliggende Mulighed, at baade den norske og den shetlandske Vaarsild afgiver Kon-
tingent til den Bestand af forarsgydende Fedsild og Storsild, der optræder paa Nordsøplateauet mellem
Shetlandsøerne og Norge, og det er iøjnefaldende, at flere af de af Broch undersøgte Prøver ligner den
norske Foraarsild langt mere end andre Prøver (se Side 21).

Om Forholdet mellem den islandske Vaarsild, den norske Nordlandssild og den sydnorske Vaarsild.

En Sammenligning mellem de anførte Analyser af islandske og norske Foraarsild viser, at disse
Sild staar hinanden grumme nær, ligesom den undersøgte Prøve af Fedsild fra Færøerne ogsaa slutter
sig tæt til den islandske og den norske Vaarsild.

Sammenholder man Analyserne fra Øfjord og fra Nordlandsdistriktet (Storsild plus Fedsild)
faas følgende Resultat:

Diff. Vert. S.	Islandssild (Øfjord) minus Nordlandssild	0.00 m. Diff.	0.071
-- Præc. Vert.	-- -- -- --	÷ 0.14	-- 0.091
-- Kølskæl	-- -- -- --	÷ 0.07	-- 0.080
-- Bugfinnestr.	-- -- -- --	+ 0.01	-- 0.075

Differensen er her for de tre Karakterer mindre end Middelfejlen paa Differensen, og for den
ene Karakter (Præc. Vert.) ca. 1.5 Gange saa stor som Middelfejlen.

Sammenligner man Analyserne fra Kongshavn paa Færøerne med Analyserne fra Nordlandsdistriktet,
faas følgende Resultat:

Diff. Vert. S.	Færøssild minus Nordlandssild	+ 0.11 m. Diff.	0.069
-- Præc. Vert.	-- -- -- --	÷ 0.11	-- 0.093
-- Kølskæl	-- -- -- --	÷ 0.06	-- 0.077
-- Bugfinnestr.	-- -- -- --	÷ 0.06	-- 0.071

Middelfejlen paa Differensen er her for Vert. S. ca. 1½ Gang saa stor, og for de andre Karakterer
nogenlunde af samme Størrelse som den fundne Differens.

Ser man hen paa Foraarsilden fra sydligere Lokaliteter ved Norges Kyster mellem Haugesund
og Aalesund, saa finder man hos denne et lidt højere Antal af Hvirvler og et lidt højere Antal af Kølskæl
end hos den islandske og færøiske Sild og Nordlandssilden, saaledes som det fremgaar af nedenstaaende
Oversigt:

Diff. Vert. S.	Vaarsild Sydnorge minus Islandssild, Øfjord	+ 0.20 m. Diff.	0.062
-- Præc. Vert.	-- -- -- --	+ 0.23	-- 0.11
-- Kølskæl	-- -- -- --	+ 0.22	-- 0.067
-- Bugfinnestr.	-- -- -- --	÷ 0.06	-- 0.089

I Antallet af Hvirvler (Vert. S.) og Kølskæl er der her en Differens, der er mere end 3
Gange Middelfejlen.

Diff. Vert. S.	Vaarsild Sydnorge minus Færøssild	+ 0.09 m. Diff.	0.060
-- Præc. Vert.	-- -- -- --	+ 0.20	-- 0.11
-- Kølskæl	-- -- -- --	+ 0.21	-- 0.063
-- Bugfinnestr.	-- -- -- --	+ 0.01	-- 0.087

I Antallet af Hvirvler (Vert. S.) og Præcaudale Hvirvler er der her en Differens paa 1½ à 2
Gange Middelfejlen og i Antallet af Kølskæl en Differens af over 3 Gange Middelfejlen.

Det fremgaar af den her givne Oversigt, at der ingen virkelig Forskel er konstateret i Antallet af
Hvirvler, Kølskæl og Bugfinnestraaler hos følgende Sild:

1. Islandske Storsild fra Øfjord.
2. Færøiske Fedsild fra Kongshavn.
3. Norske Storsild og Fedsild fra Nordlandsdistriktet.

Mellem de to førstnævnte Grupper af Sild paa den ene Side og den fuldmodne sydnorske Foraarsild paa den anden Side, er der konstateret en ringe Differens, dels m. H. t. Totalantallet af Hvirvler, dels med Hensyn til Kølskællene (K 2). Om Forholdet mellem Nordlandssilden og den sydvestnorske Vaarsild se nedenfor.

Hvad der først og fremmest falder i Øjnene ved de anførte Sammenligninger er den store Lighed mellem alle de undersøgte Foraarsild fra Island, Færøerne og Norges Kyster. Denne Lighed maa rimeligvis dels forklares ved, at forskellige ydre Kaar, bl. a. Temperaturen, er nogenlunde ensartede paa de Steder, hvor Silden fra disse forskellige Omraader har deres Gydepladser, dels ved, at Silden i større eller mindre Udstrækning vandrer fra det ene Omraade til det andet. Saavel den islandske Vaarsild som den store norske Vaarsild har Gydetid ved Foraarets Begyndelse i Marts—April og opsøger til Gydesteder de varmeste Omraader ved de paagældende Kyststrækninger. Den norske Vaarsild gyder overvejende paa Strækningen fra Flækkefjord til Aalesund, og sandsynligvis indenfor Intervallet fra 0—100 Favne. Vandets Temperatur er her i Marts—April ca. 3—6° C. Den islandske Vaarsild gyder i Hovedsagen ved Islands vestlige og sydvestlige Kyster. Det er ikke nøjere oplyst, i hvilken Dybde dens Æg afsættes, og hvilken Temperatur, der hersker paa Gydestederne, men det drejer sig vistnok om Temperaturer omtrent som den ovenfor anførte mellem ca. 2° og ca. 6° C.

Saavel Fedsilden som Storsilden strejfer baade ved Norges og ved Islands Kyster vidt omkring, og søger i Sommertiden overvejende hen til Omraader, hvor der er koldere end paa Gydepladserne.

De af HJORT¹ tilvejebragte Oplysninger om Sildens Udbredelse i Nordhavet taler paa ingen Maade imod den Antagelse, at Silden i en vis Udstrækning vandrer fra det ene af disse Omraader til det andet. Paa saa at sige hele Strækningen fra Norges Nordsøkyst over Tangen og Færøerne til Island er der paa-vist Sild i større eller mindre Mængde. Ved „Michael Sars“ St. 2. d. 25. Juli 1900 fangedes f. Eks. i Nordhavet ved 63°53' N. 7°15' E. og 1072 Favnes Dybde i Drivgarn i Overfladen 365 Sild af 29—35 cm Længde. Under Undersøgelsen N. O. for Færøerne toges ofte Sild i Mavnerne paa Torsk, Helleflynder, Macrurus og Molva byrkelange, der fangedes paa Dybder til over 200 Favne. Dette viser hen til, at Silden her har en stor vertikal Udbredelse. I Følge HJORT er det en almindelig Erfaring, som de norske Storegiskere har gjort, at der findes Sild i Langen (Molva molva), som fanges paa ca. 200 Favnes Dybde. Meget interessant er HJORTS Paavisning af, at der forekommer Sild i Nordhavet midt imellem Norge og Jan Mayen. Ved St. 26 d. 19. Juni 1901 ved 69°37' N. og 2° 58' E. og 240 Sømil fra Kysten fangedes her fra Sejlkutteren »Mira« i Drivgarn 5 Sild af 28, 28, 29, 32 og 33 cm Længde. Af disse var de to mindste Fedsild, de tre største Blodsild. Den Omstændighed, at der her fandtes Blodsild, beviser, at det ikke alene er Ungsilden, der begiver sig paa meget lange Vandringer, men at den voksne Sild ogsaa efter Gydningen kan strejfe meget vidt omkring. Tiden for Fangsten af denne Blodsild viser, at der her er Tale om Vaarsild.

Af Lighedspunkter mellem den islandske Foraarsild, den norske Nordlandssild og den sydnorske Foraarsild kan endnu fremhæves, at disse alle i 10—15 Aars Alderen, naar Væksten nærmer sig sin Afslutning, har praktisk talt samme Gennemsnitsstørrelse: ca. 34—36 cm (se Sammenligningen Side 27—28).

I Følge LEA's Undersøgelser har Aargangene 1899 og navnlig 1904 været forholdsvis stærkt repræsenterede i Fangsterne af de norske Vaarsild, saavel fra Nordlandsdistriktet som fra det sydlige Norge. Ved Islands Kyster har Aargangen 1899 ogsaa i Følge LEA været forholdsvis rigt repræsenteret — saavel som Aargangen 1898. Om Aargangen 1904 har været særlig rigt repræsenteret ved Islands Kyster, foreligger der ikke tilstrækkelige Undersøgelser over.

Med Hensyn til de fundne Forskelligheder mellem den islandske Foraarsild og den sydvestnorske Foraarsild, da anser jeg det for mest sandsynligt, at de skyldes visse Gennemsnitsforskelligheder i Natur-

¹ JOHAN HJORT: Norsk Havfiske. Norges Fiskerier. I. Udgivet af Selskabet for de norske Fiskeriers Fremme. Bergen 1905.

forholdene paa Gydepladserne for de to Grupper af Sild.¹ Ved Blanding af Individier af de to Grupper kan Differenserne blive mere eller mindre udviskede. Iøvrigt kan man endnu ikke vide, om man altid vil kunne holde Sild, der er udviklede ved Norges sydvestlige Kyster, og Sild, der er udviklede ved Islands Kyster, ude fra hinanden. Muligt er det, at der er en ret betydelig Oscillation i de undersøgte Karakterer baade hos den islandske Vaarsild og hos den norske Vaarsild, saaledes at Middelværdierne af de undersøgte Karakterer for enhver af disse Grupper ikke bliver ganske ens paa alle Lokalteter i samme Aar, og heller ikke ganske ens paa samme Lokaltet i forskellige Aar.

De fundne Differenser mellem den sydvest-norske Vaarsild og Nordlandssilden kan forklares paa forskellig Maade. Fremtidige Undersøgelser maa afgøre, hvilken Forklaring der er den rette. Følgende Muligheder kan tages i Betragtning:

Første Mulighed.

De fundne Differenser mellem Vaarsilden fra Norges Nordlandskyster og Vaarsilden fra det sydvestlige Norge kan skyldes den Omstændighed, at de førstnævnte Sild, der er undersøgte som Fedsild eller Storsild, ikke har været ublandede store Vaarsild, men har indeholdt Bestanddele af lokale Stammer med et lavere Antal Hvirvler og et lavere Antal Kølskæl.

Som tidligere omtalt har HJ. BROCH paavist, at der i visse af de norske Fjorde, som Trondhjemsfjord og Beistadfjord, forekommer lokale Sildestammer med et ringere Antal af Hvirvler og Kølskæl end den sydnorske Vaarsild.² Disse lokale Sildestammer afviger imidlertid saa betydeligt fra den sydnorske Vaarsild i Totalantallet af Hvirvler (Vert. S.), at et Blandingsprodukt mellem disse og den sydnorske Vaarsild ved Analyserne og Beregningen af Middelfavgigelsen (σ) sandsynligvis vilde give en kende- lig højere Værdi for denne end den faktisk forefundne hos Nordlandssilden. Analyserne af denne Sild har stadig vist en lige saa lav Værdi for Middelfavgigelsen (σ) for Vert. S. som Analyser af den kønsmodne sydnorske Vaarsild (se Side 17—21).

Et konkret Eksempel vil oplyse dette Forhold nærmere. —

BROCH's Analyser af Silden fra Beistadfjord har givet følgende Resultat.

Beistadfjord. April 1905. 100 Individier, Modenhedsgrad I—V. Længde 201—262 mm (Gennem- snitlig 221 mm).

Hvirvler (Vert. S.)		Præc. Vert.		K 2		Bugfinnestraaler	
Antal	Hyppighed	Antal	Hyppighed	Antal	Hyppighed	Antal	Hyppighed
53	1	22	1	12	4	15	2
54	1	23	23	13	41	16	2
55	3	24	45	14	48	17	6
56	38	25	26	15	7	18	90
57	51	26	5	..	..	..	..
58	6	..	..	..	..	..	..
n	100		100		100		100

¹ HEINCKE ansaa den islandske Sild for en egen Race, der er vel adskilt fra den norske Storsild. Han angiver følgende Forskelligheder mellem dem (Naturgeschichte des Herings. Abhandlungen des deutschen Seefischerei-Vereins Bd. II. Berlin 1896).

Islandske Sild.	Norske Storsild.
1. Halen temmelig lang.	Halen kort.
2. Snuden meget kort.	Snuden temmelig lang.
3. Øjnene overordentlig store.	Øjnene smaa.
4. Kraniets Længde—Bredde Index stor, i Middelværdi 31, altsaa <i>brachycephal</i> .	Kraniets Længde—Bredde Index temmelig lille (ca. 30), altsaa <i>mesodolichocephal</i> .

Det Materiale, HEINCKE har haft til Raadighed, er imidlertid for den islandske Silde Vedkommende ikke af en saadan Art, at der kan baseres nogen videregaaende Slutninger paa det i den anførte Retning. Det drejer sig kun om 24 voksne Individier fra ukendt Fangststed og med ukendt Gydetid. Hertil kommer, at de nævnte Karakterer undergaar Forandringer under Individernes Udvikling og Vækst, og at Omfanget af disse Forandringer ikke er kendt.

² I danske Farvande viser det sig ogsaa regelmæssigt, at Silden i Fjordene har et lavere Antal af Hvirvler og Kølskæl end Silden i de tilgrænsende mere aabne Farvande. For Aalekvabben Vedkommende har DR. JOHNS. SCHMIDT fundet, at Antallet af Hvirvler, Pigstraaler og Pigmentpletter som Regel er lavere i Fjordene end udenfor disse (JOHNS. SCHMIDT: Race-Undersøgelser. I. *Zoarces viviparus* L. og dens lokale Racer. Medd. fra Carlsberg Laboratoriet. 18. Bd. 3. H. 1917).

m	56.55	24.11	13.58	27.84
σ	0.78	0.85	0.68	0.55
σ_m	0.078	0.085	0.068	0.055
σ_σ	0.055	0.060	0.048	0.039

Blander man disse 100 Sild fra Beistadffjord med de paa Side 16 omtalte 461 Vaarsild fra det sydvestlige Norge, faas følgende Resultat for Vert. S.

Vert. S.			
53	1		
54	1	m	57.38
55	3	σ	0.84
56	66	σ_m	0.035
57	236	σ_σ	0.025
58	218		
59	34		
60	2		
n	561		

Det vil ses, at Middelfvigelsen (σ) her har en paafaldende høj Værdi i Forhold til den Værdi, den har i Blandingens enkelte Komposanter og i de undersøgte Prøver af Nordlandssilden.

Anden Mulighed.

Man har ingen Sikkerhed for, at det relativt høje Antal af Hvirvler og Kølskæl hos den sydvestnorske Vaarsild er noget konstant Træk hos alle Aargange. Der kan muligvis være en Forskel mellem de forskellige Aargange, f. Eks. som Følge af Forskelligheder i visse hydrografiske Faktorer under Yngelens Udvikling.¹ De undersøgte sydvestnorske Vaarsild kunde da tænkes at omfatte relativt flere Individer af Aargange med et højt Antal Hvirvler og Kølskæl end de undersøgte Nordlandssild.

Tredje Mulighed.

De fundne Differenser mellem Foraarsilden fra det sydlige Norge og Nordlandssilden kan maaske føres tilbage til den Omstændighed, at der er en vis gennemsnitlig Forskel i Naturforholdene paa de Steder, hvor disse Sild har deres Gydepladser. I saa Fald kan Differensen muligt være fæstnet ved Arv.

Hvis den fundne Differens mellem Nordlandssilden og den sydnorske Vaarsild maa forklares som en Raceforskel, er det sandsynligt, at Nordlandssilden overvejende gyder i den nordlige og koldere Del af Gydefeltet for Silden ved Norges Kyster, maaske mellem Bremanger og Trondhjemsfjorden, medens den norske Sild fra Skagerak og de tilgrænsende Dele af Nordsøen fortrinsvis gyder i et sydligere og varmere Omraade, omkring Haugesund og Bergen etc.

Det er i denne Sammenhæng interessant at iagttage THOR IVERSEN's Kort² over de Omraader, hvor Fiskeriet efter de fuldmodne Vaarsild finder Sted ved Norges Kyster. Hovedfiskeriet foregaar efter dette Kort dels i et nordligere Omraade omkring Bremanger og Stat, dels i to sydligere Omraader (Flækkefjord—Stavanger og Stavanger—Haugesund—Bergen). Dette Kort af THOR IVERSEN har dannet Grundlaget for Fremstillingen af Fiskepladserne paa Fig. 10 Side 31 for saa vidt de norske Kyster angaar.

Der er her Anledning til at pege paa, at en af de undersøgte Prøver af Sild fra Aalesund (Jan. 1906) i de undersøgte Karakterer (Vert. S. og K 2) ligner Nordlandssilden langt mere end de andre undersøgte Vaarsild fra det sydvestlige Norge (se Side 16).

Det er sandsynligt, at Fedsilden og Storsilden baade fra de nordlige og sydlige Gydeomraader i Sommertiden for en meget væsentlig Del træffes nord for Gydefelterne, bl. a. i Nordlandsdistriktet, saa-

¹ Dr. JOHS. SCHMIDT har vist, at Temperaturen kan have Indflydelse paa Antallet af Rygfinnestraaler hos Helsøskende af den amerikanske Tandkarpe *Lebistes reticulatus* Regan. (JOHS. SCHMIDT: Race-Undersøgelser II. Fortsatte Konstansundersøgelser. Meddelelser fra Carlsberg Laboratoriet. 14. Bd. Nr. 1. København 1917).

² THOR IVERSEN: Om en subvenert ferskfiskrute. Aarsberetning vedk. Norges Fiskerier for 1915.

ledes at de Sild, der træffes der, kan stamme fra begge Grupper af Gydepladser. Der er da en Mulighed for, at Forskellen mellem de Sild, der gyder i de nordlige Gydeomraader, og de Sild, der gyder i de sydlige Gydefelter, er større end den Forskel, der er fundet mellem Nordlandssilden og den sydvestnorske Foraarsild, idet de førstnævnte kan have været et Blandingsprodukt af to forskellige Racer.

Fjerde Mulighed.

De tidligere omtalte Forskelligheder mellem forskellige store foraarsgydende Sild fra Norges Kyster kan være Raceforskelligheder, der er opstaaede i Fortiden af Grunde, der nu er ukendte. Denne Mulighed er dog i det her foreliggende Tilfælde meget fjerntliggende.

Som det fremgaar af det foregaaende, slutter de store Foraarsild fra Island, Norges Nordhavs-kyster og Norges Nordsø- og Skagerakkyster sig meget tæt til hinanden. Hvorvidt det vil være praktisk gennemførligt indenfor disse Sild at skelne mellem flere hinanden meget nærstaaende Racer, kan ikke endnu afgøres, men overfor alle andre Sild fortjener de at betragtes under ét. Den er Europas største foraarsgydende Sild, og den udmærker sig overfor alle andre Sild ved et relativt højt Antal Hvirvler i Forening med et relativt ringe Antal Kølskæl. Det er da naturligt at have en fælles Betegnelse for denne Gruppe af Sild. Jeg foreslaar hertil Navnet Den Atlanto-Skandiske Foraarsild. Om denne Sild ogsaa yngler ved Færøerne, er ikke oplyst, men der optræder i hvert Fald ved Færøerne en Ugsild og Fedsild, som utvivlsomt hører med til den samme Formgruppe.

Til Sammenligning med Hvirveltallet hos Den Atlanto-Skandiske Foraarsild er der i Tabel I Side 33—35 givet en Oversigt over Hvirveltallet af foraarsgydende Sild fra Skotlands Vestkyst, Nordsøen, det sydøstlige Skagerak, Kattegat, Belthavet og Limfjorden.

Den foraarsgydende Havsild i hele det store Havomraade mellem Norge, Færøerne og Island, er langt mere ensartet end Foraarssilden i de smaa Farvande: Kattegat og Belthavet. (Tabel I Side 33—35). Den sandsynlige Forklaring til dette Forhold er, at nogle af de vigtigste hydrografiske Faktorer — som Vandets Saltholdighed og Temperatur — er langt mere ensartede og har i lang Tid været mere ensartede paa Foraarssildens Gydepladser i det førstnævnte end i de sidstnævnte Omraader. I Kattegat med Belthavet varierer Vandets Saltholdighed paa Gydepladserne for den foraarsgydende Sild fra ca. 10—30 ‰, og Temperaturen fra ca. 2 til ca. 12° C. Differensen i Saltholdigheden og Temperaturen indenfor Gydepladserne for de store foraarsgydende Sild ved Islands og Norges Kyster er langt mindre, men nøjagtige Tal for denne Differens kan endnu ikke gives.

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